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WILLAMETTE VALLEY METROPOLITAN AREA AIR POLLUTANT EMISSION INVENTORY

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A summary is presented of the emission inventory for the Willamette Valley Metropolitan area. The report provides estimates of the present levels of air pollutant emissions and status of their control. The pollutants which include sulfur oxides, particulates, carbon monoxide, hydrocarbons and nitrogen oxides are delineated with respect to source type, season of the year, and geographical distribution within the area. The study area which was chosen on the basis of the distribution of population and air pollution sources, consists of 10 counties in the State of Oregon which included the cities of Portland, Salem and Eugene and 5 counties in the State of Washington. A grid coordinate system was used to show the geographical distribution of emissions within counties. All sources of emissions were divided into six categories: transportation, stationary fuel combustion, industrial processes, refuse and evaporative losses and miscellaneous combustion.

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Prepared by
Alan J. Hoffman
Division of Air Quality and Emission Data

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Environmental Health Service
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4. Lane Regional Air Pollution Authority
5. Washington County Health Department
6. Washington State Air Pollution Control Board
7. Southwest Air Pollution Control Authority

PREFACE

This report, which presents the emission inventory for the Willamette Valley Metropolitan Area, is another in a series of surveys outlining the sources and emissions of air pollutants for major metropolitan areas in the country. These surveys, conducted by the National Inventory of Air Pollutant Emissions and Control Branch of the National Air Pollution Control Administration, provide estimates of the present levels of air pollutant emissions and status of their control. The pollutants, which include sulfur oxides, particulates, carbon monoxide, hydrocarbons and nitrogen oxides, are delineated with respect to source type, season of the year and geographical distribution within the area. The general procedure for the surveys is based upon the rapid survey technique for estimating air pollutant emissions.[1] These reports are intended to serve as aids in the proposing of boundaries of Air Quality Control Regions, as directed by the Air Quality Act of 1967.

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INTRODUCTION

This report is a summary of the Willamette Valley area air pollutant emission inventory conducted in September 1969. Since all inventories are based upon a calendar year, the data and emission estimates presented are representative of 1968 and should be considered as indicating the conditions as existed during that year.

The Study Area, which was chosen on the basis of the distribution of population and air pollution sources, consists of 10 counties in the State of Oregon which included the cities of Portland, Salem and Eugene and 5 counties in the State of Washington. This area covers approximately 19,950 square miles and had a 1968 population of 1,675,000.

A grid coordinate system was used to show the geographical distribution of emissions within counties. The Study Area was subdivided into 71 grids zones ranging in size from 25 square kilometers in the heavily populated and industrialized areas to 400 square kilometers in the rural areas.

All sources of emissions were classified into six categories--transportation, stationary fuel combustion, industrial processes, refuse and evaporative losses and miscellaneous combustion. Each of these source categories was divided into two subgroups--point sources and area sources. Facilities, which emit large quantities of air pollutants, were considered individually as point sources, while the many remaining contributors such as motor vehicles, residential fuel users, small commercial and industrial facilities and on-site refuse burning equipment, were considered collectively as area sources. For this report, 186 individual sources, which had emissions greater than 0.5 tons per average annual day for any pollutant, were classified as point sources.

Emissions were estimated by using various indicators such as fuel consumption, refuse burning rates, vehicle-miles, production data, and

control efficiencies and emission factors relating these indicators to emission rates.[2] These factors represent average emission rates for a particular source category. Since individual sources have inherent differences that cannot always be taken into consideration, discrepancies between the actual and estimated emissions are more likely in individual sources than in the total emissions for a source category.

As in all emission surveys, the data presented are estimates and should not be interpreted as absolute values. The estimates are, in some cases, partial totals due to the lack of emission factors and production or consumption data. Despite these limitations, the estimates are of sufficient accuracy and validity in defining the extent and distribution of air pollutant emissions within the Study Area.

SUMMARY OF RESULTS

The estimated annual emissions of the five surveyed pollutants in the Willamette Valley Study Area are presented in Table 1. The following is a brief summary of pollutant emissions and sources.

Sulfur Oxides — The predominant sources of the 49,600 tons of sulfur oxides emitted annually are the combustion of fuels (38 percent) and industrial process losses (48 percent).

Particulate Matter — The annual emissions of 118,200 tons are distributed between the various source types. The largest source is industrial processes with field and slash burning the second largest.

Carbon Monoxide — Motor vehicles contribute 68 percent of 1,018,000 tons of carbon monoxide emitted within the Study Area in 1968. Other important sources include solid waste disposal, industrial processes and field and slash burning.

Hydrocarbons — The two largest sources of the yearly 187,000 tons of hydrocarbons are motor vehicles and evaporative losses. They contribute 31 and 29 percent, respectively.

Oxides of Nitrogen — Motor vehicles and stationary fuel combustion are the important sources of the 70,600 tons of oxides of nitrogen.

TABLE 1 SUMMARY OF AIR POLLUTANT EMISSIONS FOR THE WILLAMETTE VALLEY STUDY AREA, 1968 (Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Transportation					
Motor Vehicles	3,560	6,380	687,800	55,360	40,590
Other	1,690	1,600	11,750	3,310	2,930
Subtotal	5,250	7,980	699,550	58,670	43,520
Stationary Fuel Combustion					
Industrial	11,100	1,460	100	90	8,510
Commercial and Institutional	4,860	530	60	60	2,600
Residential	3,240	930	210	310	1,960
Subtotal	19,200	2,920	370	460	13,070
Solid Waste Disposal					
Incineration	500	2,290	10,930	200	750
Open Burning	650	10,400	55,260	19,550	7,160
Subtotal	1,150	12,690	66,190	19,750	7,910
Industrial Processes	24,000	77,200	140,000	44,100	3,460
Evaporative Losses					
Motor Vehicles	--	--	--	33,830	--
Other	--	--	--	19,740	--
Subtotal	--	--	--	53,570	--
Miscellaneous					
Slash Burning	0	6,780	43,400	2,170	1,340
Field Burning	0	10,750	68,000	8,300	1,330
Subtotal	0	17,530	111,400	10,470	2,670
TOTAL*	49,600	118,300	1,017,500	187,100	70,600

* Rounded to nearest hundred

TABLE 1A SUMMARY OF AIR POLLUTANT EMISSIONS FOR THE WILLAMETTE VALLEY STUDY AREA, 1968 (10^3 Kg/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Transportation					
Motor Vehicles	3,230	5,790	623,830	50,210	36,820
Other	1,530	1,450	10,660	3,000	2,660
Subtotal	4,760	7,240	634,490	53,210	39,480
Stationary Fuel Combustion					
Industrial	10,070	1,320	90	80	7,720
Commercial and Institutional	4,410	480	60	60	2,360
Residential	2,940	840	190	280	1,780
Subtotal	17,420	2,640	340	420	11,860
Solid Waste Disposal					
Incineration	450	2,080	9,910	180	680
Open Burning	590	9,430	50,120	17,730	6,490
Subtotal	1,040	11,510	60,030	17,910	7,170
Industrial Processes	21,770	70,000	127,000	40,000	3,140
Evaporative Losses					
Motor Vehicles	--	--	--	30,680	--
Other	--	--	--	17,900	--
Subtotal	--	--	--	48,580	--
Miscellaneous					
Slash Burning	0	6,150	39,360	1,970	1,220
Field Burning	0	9,750	61,680	7,530	1,210
Subtotal	0	15,900	101,040	9,500	2,430
TOTAL*	45,000	107,300	922,900	169,600	64,100

* Rounded to nearest hundred

STUDY AREA

The Study Area for the Willamette Valley Air Pollutant Emission Inventory consists of 10 counties in northwest Oregon and five counties in southern Washington. The Oregon portion of the Study Area contains 67 percent of the State's population. Figure 1 presents the Study Area in relation to other large metropolitan areas.

The ten counties in Oregon consist of Clackamas, Columbus, Multnomah, Benton, Marion, Linn, Polk, Yamhill, Lane and Washington. The five in Washington are Clark, Cowlitz, Lewis, Skamania and Wahkiakum (Figure 2). Seven of the counties are in designated Standard Metropolitan Statistical Areas as defined by the Bureau of the Budget. The SMSA's are Portland (Multnomah, Clackamas, Washington and Clark counties), Eugene (Lane County) and Salem (Marion and Polk counties). The other counties were added to the study to insure that all counties which may have a high rate of growth in future years or counties that had potentially large point sources were included.

The approximate population for the Study Area was 1,675,000, which covered 19,950 square miles. Table 2, which gives population by county and Figure 3, which shows population density, indicate that most of the population is in the urbanized portions of Multnomah, Clark, Lane and Marion counties. The population in this area has increased at a quicker pace than the nation as a whole. Between 1960 and 1968, the nation's population increased around 11 percent while the Study Area increased 20.2 percent.

The climate is typically mild with rainy winters. About 88 percent of the total rainfall occurs in the months between October through May. Extended periods of extreme temperatures are rare. The prevailing winds are from the northwest April through September averaging about 7 MPH. During the rest of the year, the east-southeast predominates with an average speed of 9 MPH.

Figure 1. Willamette Valley study area and surrounding area.

Figure 2. Willamette Valley study area.

TABLE 2 POPULATION AND AREA CHARACTERISTICS FOR THE WILLAMETTE VALLEY STUDY AREA, 1968

County	Population		Area Mi.^{2}	Population Density 1968
	1960	1968		
Clark	93,810	116,800	627	186.3
Cowlitz	57,800	69,150	1,144	60.4
Lewis	41,860	47,700	2,449	19.5
Skamania	5,210	5,980	1,672	3.6
Wahkiakum	3,430	3,770	261	14.4
Clackamas	113,000	159,000	1,884	84.4
Columbia	22,380	29,470	640	41.4
Multnomah	522,800	555,700	423	1,314.0
Benton	39,170	48,150	668	72.1
Marion	120,890	153,260	1,166	131.4
Linn	58,870	67,250	2,291	29.4
Polk	26,520	33,700	736	45.8
Yamhill	32,480	41,000	711	57.7
Lane	162,890	206,300	4,562	45.2
Washington	92,240	137,100	716	191.5
TOTAL	1,393,350	1,674,330	19,950	83.9

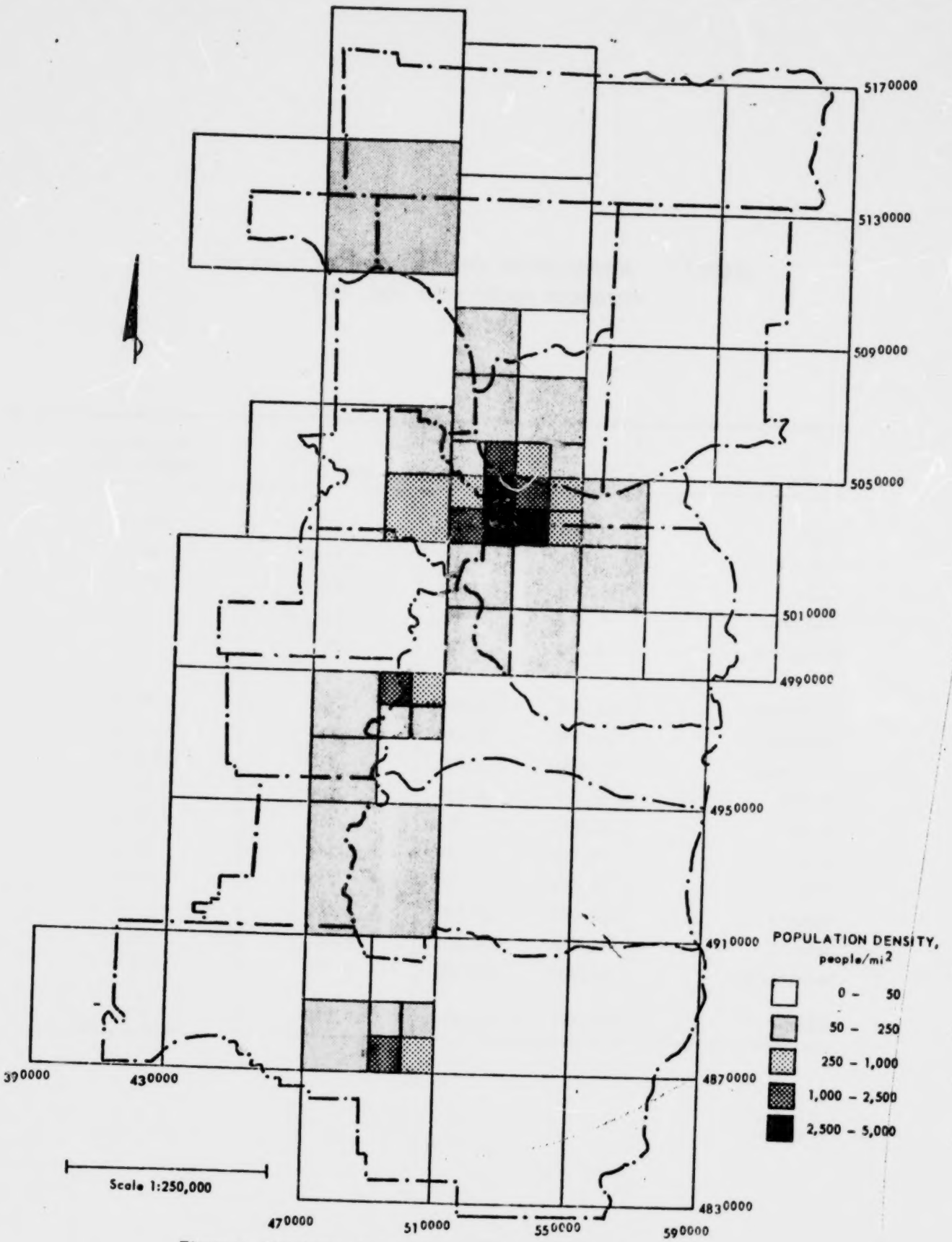

Figure 3. Population density for Willamette Valley study area, 1968.

GRID COORDINATE SYSTEM

A grid coordinate system, based on the Universal Transverse Mercator Projection (UTM), was used in the Willamette Valley Study Area to indicate the geographical distribution of emissions. A map showing the grid coordinate system is presented in Figure 4.

An evaluation of all the available coordinate systems was completed before the UTM system was chosen to present emissions. The most convenient systems evaluated were the State Plane, Longitude-Latitude, and UTM. Although each of the systems had valuable qualities, the use of the UTM coordinate system was felt to be necessary to meet the requirements of these emission inventories.

The two primary requisites of the grid coordinate system were used to evaluate each system. The first requirement was that the grid coordinate system had to have square grid zones, since the data were to be used in meteorological dispersion models. The grid zones, which the UTM system and most of the State Plane systems project, are always square, but the longitude-latitude system projects grid zones that become skewed as the zones become further from the equator. The other quality the grid coordinate system had to possess was consistency. Each emission inventory should be conducted on a grid coordinate system which uses the same reference point throughout the Study Area. Since some air pollutant inventories would include areas in two or more states, the State Plane systems could not be used. However, since the UTM system, as well as the longitude-latitude system, is not referenced to points in individual states, it is not influenced by jurisdiction boundaries. The UTM system was chosen since it was the only prevalent coordinate system which can project square grid zones over any Study Area using a common reference point.

The Universe Transverse Mercator Projection is based upon the metric system. Each north-south and east-west grid lines, as illustrated in Figure 4, is identified by a coordinate number expressed in meters.

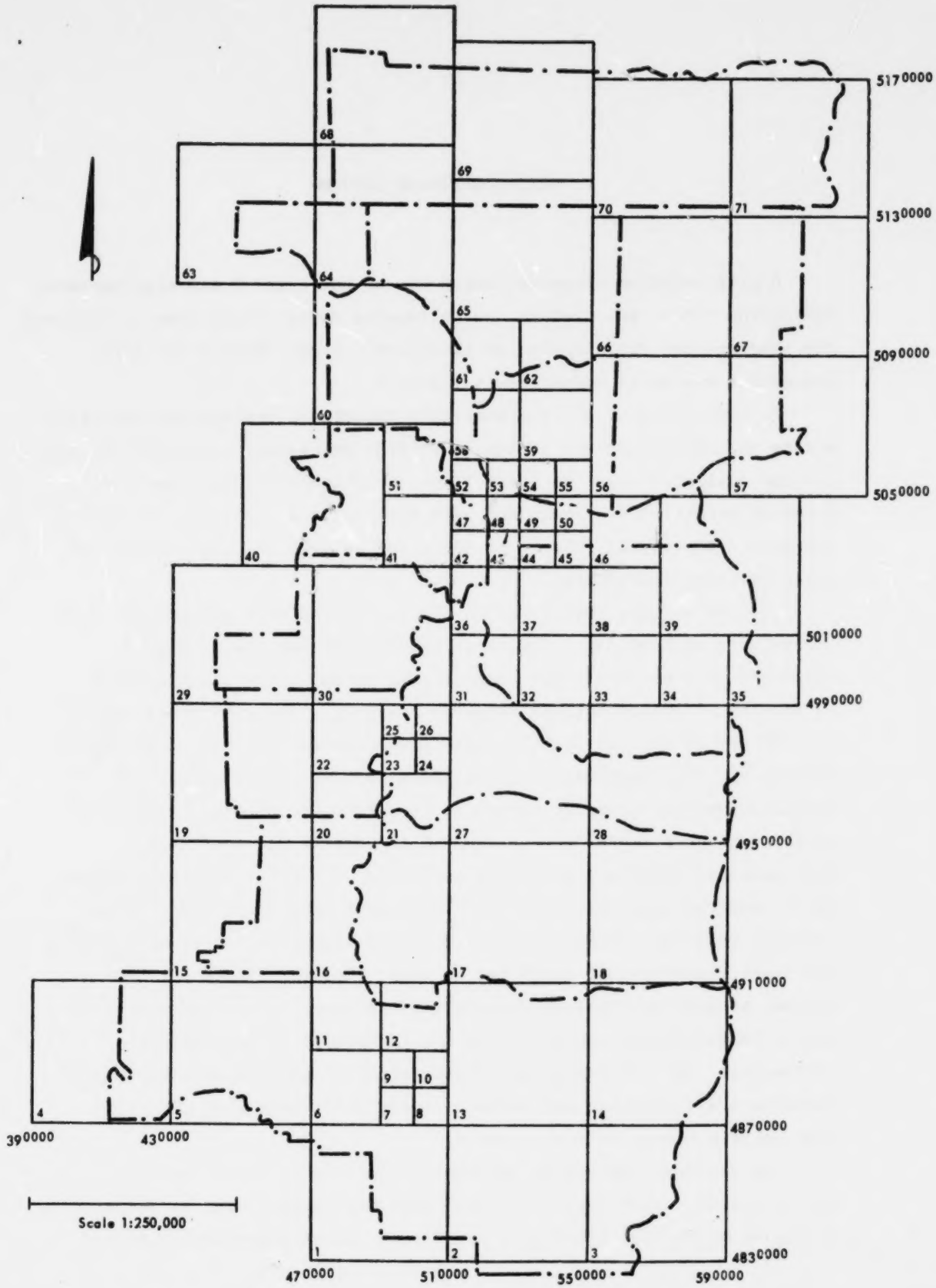

Figure 4. Willamette Valley grid system.

Each point source and grid, using its geographical center, is identified by a horizontal and vertical coordinate to the nearest 100 meters.

Grid zones of different sizes are used in the grid coordinate system to allow a satisfactory definition of the geographical gradation of emissions and to limit the number of grid zones. The majority of the emissions is usually concentrated in the populated and industrialized portions of a Study Area. Smaller grids are placed over these areas to allow the grid coordinate system to reflect the changes of emissions over short distances. Grid zones smaller than the 100 kilometer grid zones used in this report are not usually warranted because of the inherent inaccuracies in the data. Larger grid zones are used in the rural portions, because a smaller percentage of the total emissions usually occurs in lightly populated areas.

EMISSIONS BY CATEGORY

TRANSPORTATION

Transportation is the source category concerned with mobile source of air pollutants. The sources in this category include: road vehicles (both gasoline and diesel powered), aircraft, vessels, and railroads. With the exception of aircraft, all the sources are presented as area sources. Since most of the aircraft emissions are attributable to the immediate vicinity of the airports, aircraft are presented as point sources.

Road Vehicles

METHODOLOGY: Total vehicle miles of travel for 1968 were obtained from Highway Statistics using an average factor of fuel consumed per vehicle mile.[3]

The vehicle miles of travel which included both gasoline and diesel vehicles were apportionned onto the grid system by traffic flow maps where available for the major urban areas. For the balance of the Study Area emissions were apportionned by population.

Approximately 1.5 to 2.0 percent of gasoline is lost through evaporation from the gasoline tanks and carburetor losses. (This is exclusive of hydrocarbon losses from exhaust.) It was assumed that no diesel fuel was lost by evaporation. Since 1963 most new automobiles were equipped with positive crankcase ventilation (PCV) valves that reduce hydrocarbon emissions from the crankcase by about 90 percent. Due to a lag time in the automobile replacement rate, it was assumed that only 20 percent of the automobiles were not equipped with PCV valves.

RESULTS: More than 8.4 billion miles were traveled by motor vehicles in 1968. In the process, 720 million gallons of gasoline and 55 million gallons of diesel fuel were consumed for highway purposes.

Table 3 indicates that almost 60 percent of all motor vehicle travel occurs in the Portland SMSA.

TABLE 3 VEHICLE MILES OF TRAVEL AND MOTOR FUEL CONSUMPTION FOR THE STUDY AREA, 1968

County	Total Vehicle-miles 10^3/Day	Gasoline 10^3 Gal/Year	Diesel 10^3 Gal/Year
State of Washington			
Clark	1,450	36,000	4,270
Cowlitz	1,000	30,300	2,960
Lewis	820	27,900	2,410
Skanamia	80	2,520	200
Wahkiakum	50	1,540	140
State of Oregon			
Clackamas	384	7,100	1,100
Columbia	2,220	46,800	3,370
Multnomah	5,800	261,000	8,550
Benton	570	17,500	2,200
Marion	2,330	57,700	6,550
Linn	1,420	48,000	7,710
Polk	670	11,200	1,380
Yamhill	780	18,700	1,530
Lane	2,590	95,900	9,990
Washington	1,900	56,500	3,240
TOTAL	22,064	718,660	55,600

The resulting emissions from motor vehicles are shown in Table 4. Motor vehicles are by far the most significant transportation source, accounting for 98 percent of the carbon monoxide and 94 percent of the hydrocarbons.

Aircraft

METHODOLOGY: The total number of flights by type was obtained from the Federal Aviation Administration. A flight is defined as the combination of a take-off and landing. Estimates were obtained from the control tower at each airport as to the kind and number of engines in each type category. Table 5 presents the results of these estimates for the three major airports in the Study Area.

Emissions were obtained by applying the appropriate emission factors to the total number of flights in each engine and type category.

RESULTS: Table 6 presents the resulting air pollutant emissions from the three airports in the Study Area. As can be seen, the piston engines are the largest source of emissions among aircraft, accounting for 9 percent of the carbon monoxide and 92 percent of the hydrocarbons.

Trains

METHODOLOGY: The total fuel consumed by railroads in any State is given by the Bureau of Mines' Mineral Industry Surveys.[4] The proportion consumed in the Study Area was found by taking the ratio of population of the Study Area to that of the State (in both Oregon and Washington), times the total state fuel consumption. This fuel usage was apportionned to the individual grids by locating train routes and railroad yards.

RESULTS: The summary of air pollutant emission from transportation sources (Table 4) shows that trains are a significant source of particulates (20 percent) and nitrogen oxides (3 percent) from this source category.

Vessels

METHODOLOGY: The number of trips made by vessels on the Willamette

TABLE 4 AIR POLLUTANT EMISSIONS FROM TRANSPORTATION SOURCES FOR THE STUDY AREA, 1968 (Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Motor Vehicles	3,560	6,380	687,800	55,360	40,590
Gasoline					
Exhaust	2,420	3,220	686,080	51,470	34,240
Evaporation*	--	--	--	33,830	--
Diesel	1,140	3,150	1,720	3,890	6,350
Aircraft	N	650	11,270	2,240	880
Jet	N	600	460	190	380
Turboprop	N	N	N	N	N
Piston	N	50	10,810	2,050	500
Railroads	230	630	340	780	1,280
Vessels	1,460	370	140	290	770
TOTAL	5,250	7,980	699,550	58,670	43,520

* Included in the evaporative losses total

N = Negligible

TABLE 5 AIRCRAFT FLIGHTS FOR THE STUDY AREA, 1968

Airport and Engine Type	Number of Flights			
	1 Engine	2 Engine	3 Engine	4 Engine
Portland International				
Conventional	0	12,500	35,000	2,500
Fan Jet	0	500	0	0
Piston	25,000	10,500	0	0
Hillsboro Airport				
Piston	24,500	24,500	0	0
Eugene Airport				
Conventional	0	100	0	0
Fan Jet	0	5,100	0	0
Turboprop	0	900	0	0
Piston	27,000	24,000	0	0

TABLE 6 AIR POLLUTANT EMISSIONS FROM AIRCRAFT (Tons/Year), 1968

Airport	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Portland	N	600	2,790	600	470
Hillsboro	N	20	4,210	800	200
Eugene	N	30	4,270	840	210
TOTAL	N	650	11,270	2,240	880

N = Negligible

River was obtained from the Portland Commission of Public Docks. An average quantity of fuel per vessel trip was applied to the total and an average consumption of fuel while in port was used to determine the quantity of fuel consumed by this source category.

RESULTS: Air pollutant emissions from vessels are shown in Table 4. It is apparent from this table that the percent contribution from this source category to total transportation emissions is significant only for sulfur oxides (28 percent).

FUEL COMBUSTION IN STATIONARY SOURCES

Only two of the three major fuels (oil and natural gas) are consumed within the Study Area, with natural gas being the most important. In addition, wood finds usage for industrial and home heating. In 1968 natural gas accounted for 70×10^{12} BTU's of energy or about 58 percent of the total. As shown in Tables 7 and 8, 70 billion cubic feet of natural gas, 265 million gallons of distillate fuel oil and 87.2 million gallons of residual fuel oil were consumed in the Study Area.

Natural gas is consumed to a large extent by all three consumer categories. Industry consumes the largest amount with residential and commercial users about 27 percent of the total. Distillate fuel oil is consumed predominantly for residential home heating and commercial-institutional buildings. Residual fuel oil is used mainly by industrial consumers.

There are no steam-electric power plants in the Study Area. All power is hydroelectric.

METHODOLOGY: Natural gas consumption was obtained from the Northwest Natural Gas Company by county and consumer category and is considered accurate. Fuel oil figures were obtained from the Air Quality Control Section of the State Board of Health and adjusted using the state totals published by the Bureau of Mines, and thus they are approximations.[4,5]

The emissions from fuel combustion in area sources were apportionned to the individual grids by population.

RESULTS: The resulting emissions are presented in Table 9. The combustion of oil, although providing 42 percent of the energy input, produces the majority of emissions from combustion of stationary fuels. Only in the case of nitrogen oxides does natural gas (58 percent of energy) account for any significant emission rate.

Fuel combustion in stationary sources is a significant source of sulfur oxides (11 percent) and nitrogen oxides (62 percent) to the total pollution of the area.

TABLE 7 NATURAL GAS CONSUMPTION BY USER CATEGORY, 1968 (10^6 Ft^3/Yr)

County	Residential	Commercial	Industrial
State of Washington			
Clark	400	300	12,100
Cowlitz	200	200	100
Lewis	100	100	N
Skanamia	N	N	N
Wahkiakum	N	N	N
State of Oregon			
Clackamus	900	400	9,200
Columbia	100	100	5,700
Multnomah	6,100	3,200	9,200
Benton	500	100	100
Marion	1,400	400	1,400
Linn	800	300	5,600
Polk	100	100	100
Yamhill	100	100	1,700
Lane	900	600	4,500
Washington	1,200	600	600
TOTAL	12,800	6,500	40,300

TABLE 8 FUEL OIL CONSUMPTION BY CONSUMER CATEGORY FOR THE WILLAMETTE VALLEY STUDY AREA, 1968 (10^3 Gallons)

County	Distillate Fuel Oil Residential	Distillate Fuel Oil Commercial	Residual Fuel Oil Industrial
State of Washington			
Clark	9,800	2,700	6,200
Cowlitz	5,700	2,300	4,600
Lewis	4,900	2,100	4,500
Skanamia	610	140	400
Wahkiakum	460	80	300
State of Oregon			
Clackamus	8,730	1,260	1,140
Columbia	3,340	890	5,710
Multnomah	92,400	37,690	53,700
Benton	3,010	2,220	780
Marion	11,700	2,850	2,520
Linn	3,650	2,560	810
Polk	5,680	30	0
Yamhill	4,540	940	970
Lane	16,370	3,830	3,670
Washington	9,180	2,070	1,900
TOTAL	209,070	61,660	87,200

TABLE 9 AIR POLLUTANT EMISSIONS FROM STATIONARY FUEL COMBUSTION, 1968 (Tons/Year)

Fuel	User Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Residual Fuel Oil	Industrial	11,090	1,000	90	90	3,140
Distillate Fuel Oil	Residential	3,240	810	210	310	1,220
	Commercial-Institutional	4,860	470	60	60	2,220
	Total	8,100	1,280	270	370	3,440
Natural Gas	Residential	N	120	N	N	740
	Commercial-Institutional	N	60	N	N	380
	Industrial	10	460	10	N	5,370
	Total	10	640	10	N	6,490
TOTAL		19,200	2,920	370	460	13,070

N = Negligible

SOLID WASTE

METHODOLOGY: The total solid waste generated within the Study Area was found by applying the national average per capita generation rate of 10 pounds of refuse per day to the total Study Area resident population.[6] This generation rate includes both collected and uncollected waste. On the average 5.5 lb/day of waste is collected by municipalities for disposal. This figure includes household, commercial and industrial refuse. The remaining 4.5 lb/day includes industrial (3.0 lb/day), and commercial and other household (1.5 lb/day).

The disposal methods for the different regions were determined by personal contacts with the regional air pollution authorities. Thus, national averages of disposal method quantities were applied to the known disposal methods of the jurisdiction involved.

The emissions from large municipal and private disposal facilities were calculated individually and located within the Study Area. The remaining waste (on-site incineration, on-site open burning, and small open burning dumps) were treated as area sources and were apportionned onto the grid system by population.

RESULTS: Table 10, which is a solid waste balance for the Study Area, shows the results of the above methodology. The predominant disposal practices within the Study Area are sanitary landfills (33 percent) and open burning dumps (26 percent). There are no municipal incinerators. The majority of emissions in this category (Table 11) comes from open burning.

TABLE 10 SOLID WASTE DISPOSAL PRACTICES FOR THE STUDY AREA 1968 (10^3 Tons/Year)

County	Total Generated	Sanitary Landfills	On-Site Incineration	Open Burning Dumps	Open Burning On-Site
State of Washington					
Clark	210	0	50	100	60
Cowlitz	67	20	5	32	10
Lewis	46	12	10	19	5
Skanamia	6	0	1	3	2
Wahkiakum	4	0	1	1	2
State of Oregon					
Clackamus	290	80	50	100	60
Columbia	34	10	5	10	9
Multnomah	1,000	600	200	40	160
Benton	46	0	10	20	16
Marion	280	150	70	10	50
Linn	65	30	12	6	17
Polk	32	0	7	10	15
Yamhill	39	0	8	19	12
Lane	380	0	30	250	100
Washington	200	0	38	87	75
TOTAL	2,699	902	497	707	593

TABLE 11 AIR POLLUTANT EMISSIONS FROM SOLID WASTE DISPOSAL, 1968 (Tons/Year)

Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbon	Nitrogen Oxides
Incineration					
On-Site	500	2,290	10,930	200	750
Open Burning					
On-Site	300	4,740	25,200	8,890	3,260
Dump	350	5,660	30,060	10,660	3,900
Total	650	10,400	55,260	19,550	7,160
TOTAL	1,150	12,690	66,190	19,750	7,910

INDUSTRIAL PROCESSES

The major industries in the Study Area are in lumber and wood (sic 24) and fabricated metals (Sic 34). These two industrial categories account for 62 percent of the industrial establishments shown in Table 12.

In addition, many of the plants in the lumber and wood industry have conical metal burners (wigwams) for disposal of wood waste and other refuse. In Lane County alone there were 56 active wigwam burners in 1968. Another 56 have been inactivated since 1961.

The process emission totals include emissions from these wigwam burners. The Appendix C lists the emission factors used to transform the basic data into air pollutant emissions for both the wigwams and the wood boilers. Wood boilers are used for production of power and heat, whereas wigwam burners are mainly used for disposal of woodwaste.

In addition to the vast lumber, veneer and plywood operations in the Study Area, there are several large kraft and sulfite pulp and paper mills which are a source of particulates, sulfur oxides and carbon monoxide as well as noxious odors.

Since the area has a large supply of cheap electricity (hydro-electric power) there are several primary aluminum ore processing plants which require vast quantities of electricity in the refining process. Emissions from these plants consist mainly of particulates, most of which are fluorides, and sulfur oxides.

Besides the aforementioned industries there are a multitude of asphalt and concrete batching plants, grain storage and handling facilities, tank forms as well as several small metal foundries. Table 13 summarizes these emissions by industry type.

TABLE 12 DISTRIBUTION OF INDUSTRY BY SELECTED CLASSIFICATIONS FOR THE WILLAMETTE VALLEY STUDY AREA, 1963

County	Total	SIC CLASSIFICATION 20	24	27	32	34	35
State of Washington							
Clark	144	15	49	11	9	6	9
Cowlitz	141	6	96	7	3	2	3
Lewis	209	17	168	7	5	3	2
Skamania	17	--	15	1	--	--	--
Wahkiakum	16	--	15	1	--	--	--
State of Oregon							
Columbia	90	3	62	7	2	1	3
Clackamas	249	17	120	12	19	11	18
Multnomah	1,263	134	118	170	43	151	154
Benton	112	5	74	9	6	6	6
Marion	239	52	75	23	13	21	14
Linn	220	14	157	12	12	3	7
Polk	81	7	52	3	4	2	8
Yamhill	125	21	73	5	8	2	4
Lane	511	36	356	19	12	17	27
Washington	206	33	67	11	11	12	12

20 = Food and Kindred
24 = Limber and Wood
27 = Printing and Publishing
32 = Stone, Clay, Glass
34 = Fabricated Metals
35 = Machinery

TABLE 13 SUMMARY OF EMISSIONS FROM INDUSTRIAL PROCESSES

1968 (Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxides	Hydrocarbons	Nitrogen Oxides
Pulp and Paper	16,400	22,600	--	--	--
Aluminum	4,400	7,000	--	--	--
Lumber and Wood Products	2,030	13,600	1,700	10,000	560
Cement and Concrete	--	8,350	--	--	--
Asphalt Batching	--	5,500	--	--	--
Chemicals	540	3,030	--	--	--
Foundries	530	3,800	--	--	--
Grain	--	5,290	--	--	--
Wigwam Burners	100	3,830	137,800	12,400	700
Wood Boilers	--	4,200	500	21,700	2,200
TOTAL	24,000	77,200	140,000	44,100	3,460

EVAPORATIVE LOSSES

The sources of solvent evaporation considered in this survey were industry, dry cleaning and motor vehicles.

METHODOLOGY: Industrial solvent evaporation was found from individual source information. Dry cleaning emissions were calculated using a per capita rate of 4.0 lb/year.[7] This was apportionned to the grid system by population. Motor vehicle emissions were determined from the vehicle miles, age of vehicle and extent of control equipment (see transportation-motor vehicles). This was broken down on a grid basis in a manner similar to that used for exhaust emissions from motor vehicles.

RESULTS: There was over 53,570 tons of hydrocarbons emitted, of which 15,550 was industrial; 4,190 was from dry cleaning operations and 33,830 was from automobiles.

MISCELLANEOUS COMBUSTION

There were over 1,350,000 tons of slash burned in the Willamette Valley in 1968.[8] Slash is mainly the refuse product of logging operations. It is burned primarily to lower forest fire hazards and also for sanitation purposes. Emissions for the Study Area are shown in Table 1. Emissions by jurisdiction are presented in the next section of the report.

Nearly 1,360,000 tons (2×10^5 acres) of field burning occurred during 1968. Field burning is practiced to accomplish residue disposal, field sanitation, seedbed preparation and to some extent disease and weed control. However, it does create serious air pollution and visibility problems. Emissions for the Study Area are shown in Table 1, and tons of field and slash burning are presented in Table 14.

TABLE 14 FIELD AND SLASH BURNING IN THE WILLAMETTE VALLEY STUDY AREA, 1968 (Tons/Year)

County	Field Burning	Slash Burning
Clackamas	30,000	215,000
Columbia	--	3,000
Multnomah	--	27,000
Benton	163,000	24,000
Marion	210,000	72,000
Linn	640,000	286,000
Polk	127,000	15,000
Yamhill	59,000	48,000
Lane	119,000	661,000
Washington	11,000	6,000
TOTAL	1,359,000	1,357,000

EMISSIONS BY JURISDICTION

Tables 15 through 29 present the air pollutant emissions by jurisdiction. The previous sections of this report presented emissions primarily by source category. Note that the numbers may not add to the total because of rounding.

TABLE 15 SUMMARY OF AIR POLLUTANT EMISSIONS IN CLARK COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	247.	456.	47208.	3798.	2741.
OTHER	30.	82.	45.	101.	166.
SUB-TOTAL	277.	538.	47253.	3900.	2907.
COMBUSTION OF FUELS					
INDUSTRY					
STEAM-ELEC	791.	180.	8.	6.	1517.
RESIDENTIAL	0.	0.	0.	0.	0.
COMM AND INST.	149.	41.	9.	14.	83.
SUB-TOTAL	212.	23.	2.	2.	114.
	1152.	245.	20.	22.	1715.
REFUSE DISPOSAL					
INCINERATION	50.	249.	1100.	19.	75.
OPEN BURNING	80.	1280.	6799.	2399.	879.
SUB-TOTAL	130.	1529.	7899.	2419.	954.
PROCESS					
EVAP LOSSES	10475.	7104.	482.	321.	31.
				2514.	

TABLE 16 SUMMARY OF AIR POLLUTANT EMISSIONS IN COWLITZ COUNTY TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	170.	314.	30581.	2505.	1891.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	170.	314.	30581.	2505.	1891.
COMBUSTION OF FUELS					
INDUSTRY	585.	53.	4.	4.	176.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	91.	25.	5.	8.	46.
COMM AND INST.	181.	19.	2.	2.	94.
SUB-TOTAL	858.	98.	12.	15.	317.
REFUSE DISPOSAL					
INCINERATION	5.	25.	110.	1.	7.
OPEN BURNING	20.	335.	1784.	629.	230.
SUB-TOTAL	25.	360.	1894.	631.	238.
PROCESS	8604.	12132.	11387.	963.	56.
EVAP LOSSES				1706.	

TABLE 17 SUMMARY OF AIR POLLUTANT EMISSIONS IN LEWIS COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	139.	257.	25069.	2053.	1550.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	139.	257.	25069.	2053.	1550.
COMBUSTION OF FUELS					
INDUSTRY	572.	51.	4.	4.	162.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	78.	20.	4.	7.	35.
COMM AND INST.	165.	16.	2.	2.	81.
SUB-TOTAL	816.	89.	11.	14.	279.
REFUSE DISPOSAL					
INCINERATION	10.	50.	220.	3.	15.
OPEN BURNING	11.	191.	1019.	359.	131.
SUB-TOTAL	21.	241.	1239.	363.	146.
PROCESS	7.	437.	9489.	803.	47.
EVAP LOSSES				1377.	

TABLE 18 SUMMARY OF AIR POLLUTANT EMISSIONS IN SKAMANIA COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	13.	25.	2433.	199.	150.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	13.	25.	2433.	199.	150.
COMBUSTION OF FUELS					
INDUSTRY	50.	4.	0.	0.	14.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	9.	2.	0.	0.	3.
COMM AND INST.	11.	1.	0.	0.	5.
SUB-TOTAL	71.	7.	1.	1.	22.
REFUSE DISPOSAL					
INCINERATION	0.	5.	21.	0.	1.
OPEN BURNING	2.	40.	212.	74.	27.
SUB-TOTAL	3.	44.	234.	75.	28.
PROCESS	7.	255.	9489.	803.	47.
EVAP LOSSES				136.	

TABLE 19 SUMMARY OF AIR POLLUTANT EMISSIONS IN WAHKIAKUM COUNTY TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	8.	15.	1524.	124.	94.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	8.	15.	1524.	124.	94.
COMBUSTION OF FUELS					
INDUSTRY	38.	3.	0.	0.	10.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	7.	1.	0.	0.	2.
COMM AND INST.	6.	0.	0.	0.	2.
SUB-TOTAL	52.	6.	0.	1.	16.
REFUSE DISPOSAL					
INCINERATION	0.	5.	21.	0.	1.
OPEN BURNING	0.	16.	134.	92.	25.
SUB-TOTAL	1.	21.	156.	92.	27.
PROCESS	1.	51.	1897.	160.	9.
EVAP LOSSES				86.	

TABLE 20 SUMMARY OF AIR POLLUTANT EMISSIONS IN COLUMBIA COUNTY TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	64.	119.	11739.	959.	722.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	64.	119.	11739.	959.	722.
COMBUSTION OF FUELS					
INDUSTRY	727.	116.	6.	5.	804.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	59.	15.	3.	5.	28.
COMM AND INST.	70.	7.	0.	0.	37.
SUB-TOTAL	857.	139.	11.	12.	870.
REFUSE DISPOSAL					
INCINERATION	5.	25.	110.	1.	7.
OPEN BURNING	9.	152.	807.	285.	104.
SUB-TOTAL	14.	176.	917.	286.	111.
PROCESS	408.	3446.	380.	193.	4.
EVAP LOSSES				662.	

TABLE 21 SUMMARY OF AIR POLLUTANT EMISSIONS IN CLACKAMAS COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	314.	520.	68110.	5360.	3838.
OTHER	10.	27.	15.	34.	55.
SUB-TOTAL	324.	548.	68125.	5394.	3894.
COMBUSTION OF FUELS					
INDUSTRY	146.	95.	2.	1.	1025.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	239.	68.	15.	22.	142.
COMM AND INST.	99.	13.	1.	1.	68.
SUB-TOTAL	485.	177.	19.	25.	1236.
REFUSE DISPOSAL					
INCINERATION	50.	249.	1100.	19.	75.
OPEN BURNING	80.	1280.	6799.	2399.	879.
SUB-TOTAL	130.	1529.	7899.	2419.	954.
PROCESS	299.	12891.	13376.	955.	269.
EVAP LOSSES				3799.	

TABLE 22 SUMMARY OF AIR POLLUTANT EMISSIONS IN MULTNOMAH COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	812.	1337.	177054.	13926.	9984.
OTHER	1578.	1249.	3101.	1301.	1913.
SUB-TOTAL	2390.	2586.	180156.	15228.	11897.
COMBUSTION OF FUELS					
INDUSTRY	6832.	700.	55.	53.	2917.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	1484.	430.	94.	139.	912.
COMM AND INST.	2967.	313.	38.	37.	1542.
SUB-TOTAL	11284.	1444.	188.	231.	5372.
REFUSE DISPOSAL					
INCINERATION	200.	799.	4400.	79.	300.
OPEN BURNING	99.	1599.	8500.	2999.	1100.
SUB-TOTAL	300.	2399.	12899.	3079.	1399.
PROCESS	2065.	15530.	1416.	22789.	2232.
EVAP LOSSES				25830.	

TABLE 23 SUMMARY OF AIR POLLUTANT EMISSIONS IN BENTON COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	107.	209.	17446.	1464.	1137.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	107.	209.	17446.	1464.	1137.
COMBUSTION OF FUELS					
INDUSTRY	99.	9.	0.	0.	38.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	68.	21.	4.	6.	54.
COMM AND INST.	174.	17.	2.	2.	85.
SUB-TOTAL	342.	49.	7.	9.	179.
REFUSE DISPOSAL					
INCINERATION	10.	50.	220.	3.	15.
OPEN BURNING	17.	287.	1529.	539.	197.
SUB-TOTAL	27.	337.	1749.	543.	212.
PROCESS	14.	5073.	30999.	5044.	346.
EVAP LOSSES				993.	

TABLE 24 SUMMARY OF AIR POLLUTANT EMISSIONS IN MARION COUNTY TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	389.	713.	72145.	5865.	4365.
OTHER	10.	27.	14.	34.	55.
SUB-TOTAL	399.	740.	72160.	5899.	4421.
COMBUSTION OF FUELS					
INDUSTRY	320.	41.	2.	2.	240.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	289.	85.	18.	27.	190.
COMM AND INST.	224.	25.	2.	2.	125.
SUB-TOTAL	834.	152.	24.	32.	556.
REFUSE DISPOSAL					
INCINERATION	70.	350.	1539.	27.	105.
OPEN BURNING	29.	479.	2549.	899.	329.
SUB-TOTAL	99.	829.	4089.	927.	434.
PROCESS	803.	2641.	14070.	1515.	290.
EVAP LOSSES				3955.	

TABLE 25 SUMMARY OF AIR POLLUTANT EMISSIONS IN LINN COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	314.	648.	43531.	3805.	3090.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	314.	648.	43531.	3805.	3090.
COMBUSTION OF FUELS					
INDUSTRY	104.	59.	1.	0.	628.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	112.	34.	7.	10.	83.
COMM AND INST.	201.	22.	2.	2.	109.
SUB-TOTAL	417.	116.	11.	13.	820.
REFUSE DISPOSAL					
INCINERATION	12.	59.	263.	4.	17.
OPEN BURNING	11.	183.	977.	344.	126.
SUB-TOTAL	23.	243.	1241.	349.	144.
PROCESS	56.	15316.	75081.	12572.	1401.
EVAP LOSSES				2345.	

TABLE 26 SUMMARY OF AIR POLLUTANT EMISSIONS IN POLK COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	101.	176.	20466.	1636.	1198.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	101.	176.	20466.	1636.	1198.
COMBUSTION OF FUELS					
INDUSTRY	0.	0.	0.	0.	10.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	89.	23.	5.	8.	40.
COMM AND INST.	2.	1.	0.	0.	6.
SUB-TOTAL	91.	25.	5.	8.	57.
REFUSE DISPOSAL					
INCINERATION	7.	35.	154.	2.	10.
OPEN BURNING	12.	199.	1062.	374.	137.
SUB-TOTAL	19.	234.	1216.	377.	147.
PROCESS	7.	2882.	18182.	2519.	247.
EVAP LOSSES				1112.	

TABLE 27 SUMMARY OF AIR POLLUTANT EMISSIONS IN YAMHILL COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	117.	202.	23810.	1899.	1387.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	117.	202.	23810.	1899.	1387.
COMBUSTION OF FUELS					
INDUSTRY	123.	26.	1.	0.	216.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	75.	20.	4.	7.	34.
COMM AND INST.	74.	7.	0.	0.	39.
SUB-TOTAL	273.	54.	7.	9.	291.
REFUSE DISPOSAL					
INCINERATION	7.	40.	175.	3.	12.
OPEN BURNING	15.	247.	1317.	464.	170.
SUB-TOTAL	23.	287.	1493.	468.	182.
PROCESS	804.	2826.	6889.	872.	141.
EVAP LOSSES				1297.	

TABLE 28 SUMMARY OF AIR POLLUTANT EMISSIONS IN LANE COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	479.	919.	88654.	7165.	5118.
OTHER	59.	195.	4360.	1044.	544.
SUB-TOTAL	539.	1115.	93014.	8209.	5663.
COMBUSTION OF FUELS					
INDUSTRY	467.	82.	4.	3.	613.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	293.	82.	18.	27.	162.
COMM AND INST.	301.	34.	3.	3.	172.
SUB-TOTAL	1062.	199.	27.	35.	948.
REFUSE DISPOSAL					
INCINERATION	30.	150.	660.	12.	45.
OPEN BURNING	174.	2799.	14874.	5249.	1924.
SUB-TOTAL	204.	2949.	15534.	5261.	1969.
PROCESS	431.	13994.	55340.	4847.	978.
EVAP LOSSES				4497.	

TABLE 29 SUMMARY OF AIR POLLUTANT EMISSIONS IN WASHINGTON COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	274.	461.	58025.	4592.	3318.
OTHER	0.	19.	4214.	796.	197.
SUB-TOTAL	274.	481.	62239.	5388.	3515.
COMBUSTION OF FUELS					
INDUSTRY	241.	27.	2.	1.	132.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	187.	58.	11.	17.	139.
COMM AND INST.	163.	21.	2.	2.	109.
SUB-TOTAL	591.	106.	16.	21.	381.
REFUSE DISPOSAL					
INCINERATION	38.	190.	835.	15.	57.
OPEN BURNING	81.	1296.	6884.	2429.	890.
SUB-TOTAL	118.	1485.	7720.	2445.	947.
PROCESS	0.	140.	2359.	214.	24.
EVAP LOSSES				3255.	

EMISSIONS BY GRID

For the purpose of defining the geographical variation of air pollutant emissions in the Study Area, the resulting emissions were apportionned on the grid coordinate system. The emissions were divided into two source groups--point and area sources. The 186 point sources are identified individually with respect to location and emissions. Each of these point sources emit more than 0.5 tons per day of any pollutant.

Figure 5 shows the location of most of the point sources in the area. Collectively, the 186 point sources account for 48 percent of the sulfur oxides, 73 percent of particulates, 16 percent of carbon monoxide, 53 percent of hydrocarbons and 9 percent of nitrogen oxides. The percent contribution to carbon monoxide emissions is low because motor vehicles, which are area sources account for 68 percent of the total carbon monoxide emissions. Similarly, the contribution to total nitrogen oxide emissions is low since two groups of area sources, motor vehicles and stationary fuel combustion are major contributors. Table 30 presents the emissions of point sources. It has been assumed that seasonal variations in point sources are negligible.

Area sources are sources of emissions that are insignificant by themselves, but as a group emit a significant amount. Examples are motor vehicles, residential houses, light commercial and industrial establishments and backyard burning. The emissions from area sources have been added to that for point sources to obtain total emissions by grid as given in Table 31.

The emissions are presented for an annual average day, and average winter day (December, January, February) and an average summer day (June, July, August). The annual average daily emission rates were obtained by dividing yearly totals by 365. Seasonal averages were calculated by the use of space heating variations in fuel consumption

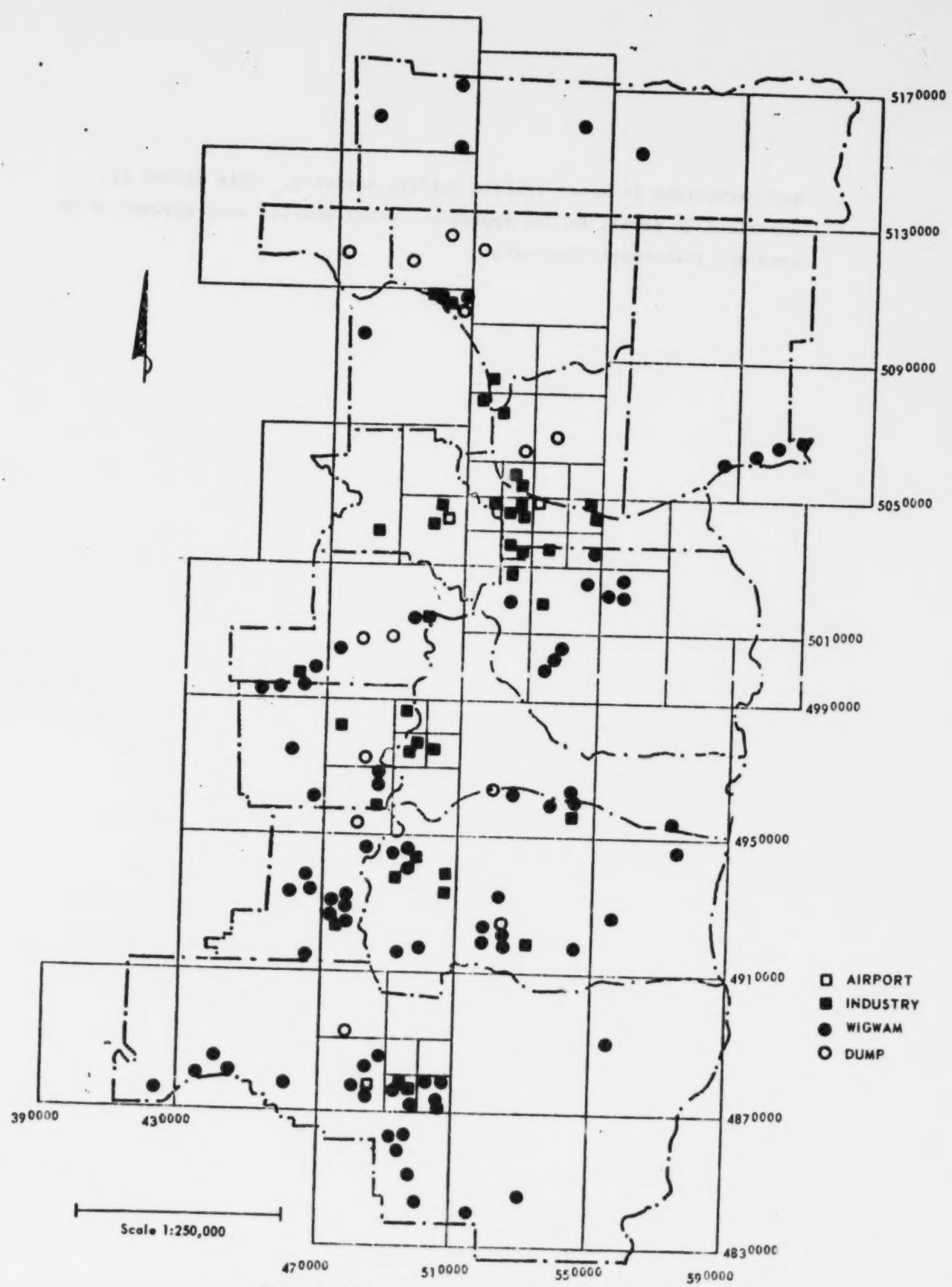

Figure 5. Point source locations for study area, 1968.

and variations in motor vehicle traffic activity. This method is described in detail in the appendix. Other sources were assumed to be constant throughout the year.

TABLE 30 SUMMARY OF AIR POLLUTANT EMISSIONS FROM POINT SOURCES
TONS/[redacted]Day

ID	GR	HC	VC	SOX			PART			CO			HC			NOX		
				S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
2	1	4980	48625	0.0	0.0	0.0	0.01	0.01	0.01	0.70	0.70	0.70	0.05	0.05	0.05	0.00	0.00	0.00
2	1	4985	48685	0.0	0.0	0.0	0.03	0.03	0.03	1.19	1.19	1.19	0.10	0.10	0.10	0.00	0.00	0.00
2	1	4960	48551	0.0	0.0	0.0	0.05	0.05	0.05	1.98	1.98	1.98	0.16	0.16	0.16	0.01	0.01	0.01
2	1	4970	48480	0.0	0.0	0.0	0.11	0.11	0.11	4.28	4.28	4.28	0.36	0.36	0.36	0.02	0.02	0.02
2	1	4964	48525	0.0	0.0	0.0	0.12	0.12	0.12	4.47	4.47	4.47	0.37	0.37	0.37	0.02	0.02	0.02
2	1	4960	48451	0.0	0.0	0.0	0.05	0.05	0.05	1.94	1.96	1.98	0.16	0.16	0.16	0.01	0.01	0.01
2	1	4990	48481	0.0	0.0	0.0	0.05	0.05	0.05	1.98	1.98	1.98	0.16	0.16	0.16	0.01	0.01	0.01
2	2	5130	49369	0.0	0.0	0.0	0.05	0.05	0.05	2.07	2.07	2.07	0.17	0.17	0.17	0.01	0.01	0.01
2	2	5320	48445	0.0	0.0	0.0	0.08	0.08	0.08	3.18	3.18	3.18	0.27	0.27	0.27	0.01	0.01	0.01
2	4	4220	49451	0.0	0.0	0.0	0.04	0.04	0.04	1.76	1.76	1.76	0.15	0.15	0.15	0.00	0.00	0.00
2	5	4320	48760	0.0	0.0	0.0	0.11	0.11	0.11	4.18	4.18	4.18	0.35	0.35	0.35	0.02	0.02	0.02
2	5	4330	48820	0.0	0.0	0.0	0.02	0.02	0.02	0.79	0.79	0.79	0.06	0.06	0.06	0.00	0.00	0.00
2	5	4640	48780	0.0	0.0	0.0	0.02	0.02	0.02	0.79	0.79	0.79	0.06	0.06	0.06	0.00	0.00	0.00
2	5	4320	48750	0.0	0.0	0.0	0.03	0.03	0.03	1.38	1.38	1.38	0.11	0.11	0.11	0.00	0.00	0.00
2	6	4890	48785	0.0	0.0	0.0	0.01	0.01	0.01	0.67	0.67	0.67	0.05	0.05	0.05	0.00	0.00	0.00
2	6	4896	48779	0.0	0.0	0.0	0.02	0.02	0.02	0.89	0.89	0.89	0.07	0.07	0.07	0.00	0.00	0.00
2	6	4870	488 0	0.0	0.0	0.0	0.04	0.04	0.04	1.48	1.48	1.48	0.12	0.12	0.12	0.00	0.00	0.00
2	6	4870	48785	0.0	0.0	0.0	0.01	0.01	0.01	0.50	0.50	0.50	0.04	0.04	0.04	0.00	0.00	0.00
2	6	4865	48765	0.0	0.0	0.0	0.02	0.02	0.02	0.99	0.99	0.99	0.08	0.08	0.08	0.00	0.00	0.00
2	6	4875	48840	0.0	0.0	0.0	0.02	0.02	0.02	0.99	0.99	0.99	0.08	0.08	0.08	0.00	0.00	0.00
2	6	4880	48785	0.0	0.0	0.0	0.03	0.03	0.03	1.19	1.19	1.19	0.10	0.10	0.10	0.00	0.00	0.00
2	6	4890	48812	0.0	0.0	0.0	0.14	0.14	0.14	5.47	5.47	5.47	0.46	0.46	0.46	0.02	0.02	0.02
2	6	4890	48794	0.0	0.0	0.0	0.03	0.03	0.03	1.29	1.29	1.29	0.11	0.11	0.11	0.00	0.00	0.00
2	6	4860	48770	0.0	0.0	0.0	0.08	0.08	0.08	11.69	11.69	11.69	2.30	2.30	2.30	0.58	0.58	0.58
2	7	4990	487 0	0.0	0.0	0.0	0.03	0.03	0.03	1.19	1.19	1.19	0.10	0.10	0.10	0.00	0.00	0.00
2	7	4915	48784	0.0	0.0	0.0	0.20	0.20	0.20	7.46	7.46	7.46	0.63	0.63	0.63	0.03	0.03	0.03
2	7	4900	48756	0.0	0.0	0.0	0.68	0.68	0.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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2	7	4935	48780	0.0	0.0	0.0	0.70	0.70	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	7	4975	48775	0.0	0.0	0.0	0.22	0.22	0.22	0.03	0.03	0.03	1.09	1.09	1.09	0.11	0.11	0.11
3	7	4980	48775	0.0	0.0	0.0	0.16	0.16	0.16	0.02	0.02	0.02	0.82	0.82	0.82	0.08	0.08	0.08
5	7	4948	48775	0.2	0.2	0.2	3.28	3.28	3.28	17.46	17.46	17.46	6.16	6.16	6.16	2.26	2.26	2.26
2	8	5015	48785	0.0	0.0	0.0	0.02	0.02	0.02	0.99	0.99	0.99	0.08	0.08	0.08	0.00	0.00	0.00
2	8	5050	48845	0.0	0.0	0.0	0.02	0.02	0.02	0.99	0.99	0.99	0.08	0.08	0.08	0.00	0.00	0.00
2	8	5015	48770	0.0	0.0	0.0	0.10	0.10	0.10	3.98	3.98	3.98	0.33	0.33	0.33	0.02	0.02	0.02
2	8	5010	48760	0.0	0.0	0.0	0.01	0.01	0.01	0.54	0.54	0.54	0.04	0.04	0.04	0.00	0.00	0.00
2	8	5040	48779	0.0	0.0	0.0	0.10	0.10	0.10	3.78	3.78	3.78	0.32	0.32	0.32	0.01	0.01	0.01
2	8	5040	48779	0.0	0.0	0.0	0.02	0.02	0.02	0.79	0.79	0.79	0.06	0.06	0.06	0.00	0.00	0.00
2	8	5039	48790	0.0	0.0	0.0	0.28	0.28	0.28	10.69	10.69	10.69	0.91	0.91	0.91	0.05	0.05	0.05
2	8	5015	48769	0.0	0.0	0.0	9.99	9.99	9.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	8	5040	48778	1.1	1.1	1.1	12.89	12.89	12.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	11	4770	48910	0.1	0.1	0.1	2.19	2.19	2.19	11.64	11.64	11.64	4.10	4.10	4.10	1.50	1.50	1.50
2	14	5520	489 0	0.0	0.0	0.0	0.08	0.08	0.08	3.18	3.18	3.18	0.27	0.27	0.27	0.01	0.01	0.01
6	15	4660	49345	0.0	0.0	0.0	0.04	0.04	0.04	1.70	1.70	1.70	0.14	0.14	0.14	0.00	0.00	0.00
6	15	4685	491 0	0.0	0.0	0.0	0.27	0.27	0.27	10.19	10.19	10.19	0.86	0.86	0.86	0.05	0.05	0.05
6	15	4685	491 5	0.0	0.0	0.0	0.11	0.11	0.11	4.26	4.26	4.26	0.36	0.36	0.36	0.02	0.02	0.02
6	15	4685	49345	0.0	0.0	0.0	0.11	0.11	0.11	4.12	4.12	4.12	0.34	0.34	0.34	0.02	0.02	0.02
6	15	4655	49375	0.0	0.0	0.0	0.04	0.04	0.04	1.59	1.59	1.59	0.13	0.13	0.13	0.00	0.00	0.00
2	16	4780	49325	0.0	0.0	0.0	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	16	4945	49445	0.0	0.0	0.0	4.94	4.94	4.94	0.00	0.00	0.00	1.93	1.93	1.93	0.08	0.08	0.08
2	16	4945	49445	0.0	0.0	0.0	1.41	1.41	1.41	0.00	0.00	0.00	0.55	0.55	0.55	0.02	0.02	0.02
2	16	5090	49330	0.0	0.0	0.0	0.50	0.50	0.50	0.06	0.06	0.06	2.47	2.47	2.47	0.24	0.24	0.24
2	16	5090	493 0	0.0	0.0	0.0	3.49	3.49	3.49	0.05	0.05	0.05	4.79	4.79	4.79	0.27	0.27	0.27
2	16	4902	494 0	0.0	0.0	0.0	0.96	0.96	0.96	0.00	0.00	0.00	1.47	1.47	1.47	0.00	0.00	0.00
2	16	4902	494 0	0.0	0.0	0.0	5.54	5.54	5.54	0.00	0.00	0.00	0.90	0.90	0.90	0.02	0.02	0.02
2	16	4765	49275	0.0	0.0	0.0	0.19	0.19	0.19	0.00	0.00	0.00	1.42	1.42	1.42	0.06	0.06	0.06
2	16	4960	49465	0.1	0.1	0.1	3.69	3.69	3.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	16	4990	49148	0.0	0.0	0.0	0.08	0.08	0.08	3.12	3.12	3.12	0.26	0.26	0.26	0.01	0.01	0.01
6	16	4945	49445	0.0	0.0	0.0	0.07	0.07	0.07	2.77	2.77	2.77	0.23	0.23	0.23	0.01	0.01	0.01
6	16	4945	49465	0.0	0.0	0.0	0.06	0.06	0.06	2.44	2.44	2.44	0.20	0.20	0.20	0.01	0.01	0.01
6	16	4765	49275	0.0	0.0	0.0	0.10	0.10	0.10	3.72	3.72	3.72	0.31	0.31	0.31	0.01	0.01	0.01

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	6	16 4740	49350	0.0	0.0	0.0	0.39	0.39	0.39	14.69	14.69	14.69	1.23	1.23	1.23	0.07	0.07	0.07
	6	16 4720	49325	0.0	0.0	0.0	0.01	0.01	0.01	0.53	0.53	0.53	0.04	0.04	0.04	0.00	0.00	0.00
	6	16 4991	49135	0.0	0.0	0.0	5.47	5.47	5.47	2.63	2.63	2.63	0.72	0.72	0.72	0.03	0.03	0.03
	6	16 4830	49475	0.0	0.0	0.0	0.83	0.83	0.83	2.55	2.55	2.55	1.49	1.49	1.49	0.06	0.06	0.06
	6	16 4715	49315	0.0	0.0	0.0	0.11	0.11	0.11	4.37	4.37	4.37	0.37	0.37	0.37	0.02	0.02	0.02
	6	16 4945	49445	0.0	0.0	0.0	0.03	0.03	0.03	1.14	1.14	1.14	0.09	0.09	0.09	0.00	0.00	0.00
	6	16 4740	49350	0.0	0.0	0.0	0.10	0.10	0.10	3.73	3.73	3.73	0.31	0.31	0.31	0.01	0.01	0.01
	6	16 4740	49340	0.0	0.0	0.0	0.01	0.01	0.01	0.48	0.48	0.48	0.67	0.67	0.67	0.00	0.00	0.00
	6	16 4720	49340	0.0	0.0	0.0	0.12	0.12	0.12	4.69	4.69	4.69	0.39	0.39	0.39	0.02	0.02	0.02
	6	16 4945	49445	0.0	0.0	0.0	0.11	0.11	0.11	4.26	4.26	4.26	0.36	0.36	0.36	0.02	0.02	0.02
	6	16 4945	49445	0.0	0.0	0.0	0.08	0.08	0.08	3.20	3.20	3.20	0.27	0.27	0.27	0.01	0.01	0.01
	6	16 4945	49445	0.0	0.0	0.0	0.70	0.70	0.70	7.04	7.04	7.04	1.66	1.66	1.66	0.03	0.03	0.03
	2	17 5290	49185	0.0	0.0	0.0	0.22	0.22	0.22	0.00	0.00	0.00	0.55	0.55	0.55	0.02	0.02	0.02
	5	17 5220	49210	0.0	0.0	0.0	0.10	0.10	0.10	0.58	0.58	0.58	0.20	0.20	0.20	0.07	0.07	0.07
	6	17 5235	49185	0.0	0.0	0.0	0.06	0.06	0.06	2.34	2.34	2.34	0.19	0.19	0.19	0.01	0.01	0.01
	6	17 5170	49210	0.0	0.0	0.0	0.01	0.01	0.01	0.53	0.53	0.53	0.04	0.04	0.04	0.00	0.00	0.00
	6	17 5215	49175	0.0	0.0	0.0	0.06	0.06	0.06	2.45	2.45	2.45	0.20	0.20	0.20	0.01	0.01	0.01
	6	17 5190	492 0	0.0	0.0	0.0	0.01	0.01	0.01	0.53	0.53	0.53	0.04	0.04	0.04	0.00	0.00	0.00
	6	17 5245	49395	0.0	0.0	0.0	0.02	0.02	0.02	0.75	0.75	0.75	0.06	0.06	0.06	0.00	0.00	0.00
	6	17 5170	49220	0.0	0.0	0.0	0.06	0.06	0.06	2.39	2.39	2.39	0.20	0.20	0.20	0.01	0.01	0.01
	6	17 5215	49165	0.0	0.0	0.0	0.06	0.06	0.06	2.34	2.34	2.34	0.19	0.19	0.19	0.01	0.01	0.01
	6	17 5285	49185	0.0	0.0	0.0	0.02	0.02	0.02	1.01	1.01	1.01	0.08	0.08	0.08	0.00	0.00	0.00
	6	17 5450	49175	0.0	0.0	0.0	0.10	0.10	0.10	3.91	3.91	3.91	0.33	0.33	0.33	0.01	0.01	0.01
	6	18 5740	49470	0.0	0.0	0.0	0.34	0.34	0.34	12.79	12.79	12.79	1.07	1.07	1.07	0.06	0.06	0.06
	6	18 5730	49485	0.0	0.0	0.0	0.10	0.10	0.10	3.84	3.84	3.84	0.32	0.32	0.32	0.01	0.01	0.01
	6	18 4925	55555	0.0	0.	0.0	0.23	0.23	0.23	8.89	8.89	8.89	0.75	0.75	0.75	0.04	0.04	0.04
	6	19 4650	495 5	0.0	0.0	0.0	0.08	0.08	0.08	3.20	3.20	3.20	0.27	0.27	0.27	0.01	0.01	0.01
	6	19 4600	497 0	0.0	0.0	0.0	0.01	0.01	0.01	0.71	0.71	0.71	0.06	0.06	0.06	0.00	0.00	0.00
	2	20 4847	49657	0.0	0.0	0.0	3.09	3.09	3.09	0.00	0.00	0.00	0.85	0.85	0.85	0.02	0.02	0.02
	5	20 4790	495 7	0.0	0.0	0.0	0.36	0.36	0.36	1.93	1.93	1.93	0.68	0.68	0.68	0.25	0.25	0.25
	6	20 4847	49657	0.0	0.0	0.0	0.43	0.43	0.43	15.99	15.99	15.99	1.35	1.35	1.35	0.08	0.08	0.08
	6	20 4847	49656	0.0	0.0	0.0	0.13	0.13	0.13	4.94	4.94	4.94	0.41	0.41	0.41	0.02	0.02	0.02
	6	20 4847	49655	0.0	0.0	0.0	0.01	0.01	0.01	0.61	0.61	0.61	0.05	0.05	0.05	0.00	0.00	0.00

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2	22	4750	49720	0.0	0.0	0.0	0.24	0.24	0.24	0.03	0.03	0.03	1.19	1.19	1.19	0.12	0.12	0.12
5	22	4930	49745	0.0	0.0	0.0	0.10	0.10	0.10	0.55	0.55	0.55	0.19	0.19	0.19	0.07	0.07	0.07
2	23	4985	49739	0.0	0.0	0.0	0.55	0.55	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	23	4965	49767	2.1	2.1	2.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	24	5009	49728	0.0	0.0	0.0	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	25	4984	498 5	0.0	0.0	0.0	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	27	5420	49570	0.0	0.0	0.0	0.33	0.33	0.33	0.04	0.04	0.04	1.64	1.64	1.64	0.16	0.16	0.16
5	27	5200	49630	0.0	0.0	0.0	0.11	0.11	0.11	0.59	0.59	0.59	0.20	0.20	0.20	0.07	0.07	0.07
6	27	5350	49585	0.0	0.0	0.0	0.12	0.12	0.12	4.48	4.48	4.48	0.37	0.37	0.37	0.02	0.02	0.02
6	27	5350	49585	0.0	0.0	0.0	0.02	0.02	0.02	1.06	1.06	1.06	0.09	0.09	0.09	0.00	0.00	0.00
6	27	5425	49565	0.0	0.0	0.0	0.08	0.08	0.08	3.20	3.20	3.20	0.27	0.27	0.27	0.01	0.01	0.01
6	27	5425	49565	0.0	0.0	0.0	0.16	0.16	0.16	6.22	6.22	6.22	0.52	0.52	0.52	0.03	0.03	0.03
6	27	5450	49585	0.0	0.0	0.0	0.07	0.07	0.07	2.66	2.66	2.66	0.22	0.22	0.22	0.01	0.01	0.01
6	27	5290	49610	0.0	0.0	0.0	0.04	0.04	0.04	1.59	1.59	1.59	0.13	0.13	0.13	0.00	0.00	0.00
6	27	5410	49570	0.0	0.0	0.0	0.06	0.06	0.06	2.53	2.53	2.53	0.21	0.21	0.21	0.01	0.01	0.01
6	27	5405	49555	0.0	0.0	0.0	0.19	0.19	0.19	0.00	0.00	0.00	0.93	0.93	0.93	0.02	0.02	0.02
6	27	5420	49590	0.0	0.0	0.0	0.03	0.03	0.03	1.20	1.20	1.20	0.10	0.10	0.10	0.00	0.00	0.00
6	28	5710	49515	0.0	0.0	0.0	0.08	0.08	0.08	3.20	3.20	3.20	0.27	0.27	0.27	0.01	0.01	0.01
2	29	4622	49924	0.0	0.0	0.0	0.13	0.13	0.13	0.01	0.01	0.01	0.65	0.65	0.65	0.06	0.06	0.06
6	29	4550	49910	0.0	0.0	0.0	0.07	0.07	0.07	2.77	2.77	2.77	0.23	0.23	0.23	0.01	0.01	0.01
6	29	4671	49944	0.0	0.0	0.0	0.05	0.05	0.05	2.04	2.04	2.04	0.17	0.17	0.17	0.01	0.01	0.01
6	29	4671	49944	0.0	0.0	0.0	0.06	0.06	0.06	2.50	2.50	2.50	0.21	0.21	0.21	0.01	0.01	0.01
6	29	4504	499 0	0.0	0.0	0.0	0.15	0.15	0.15	5.69	5.69	5.69	0.48	0.48	0.48	0.02	0.02	0.02
6	29	4615	49920	0.0	0.0	0.0	0.01	0.01	0.01	0.58	0.58	0.58	0.04	0.04	0.04	0.00	0.00	0.00
2	30	4735	49970	0.0	0.0	0.0	0.02	0.02	0.02	0.90	0.90	0.90	0.07	0.07	0.07	0.00	0.00	0.00
2	30	5020	50140	2.1	2.1	2.1	5.49	5.49	5.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	30	5009	50140	0.0	0.0	0.0	0.14	0.14	0.14	0.75	0.75	0.75	0.26	0.26	0.26	0.09	0.09	0.09
5	30	4800	50095	0.0	0.0	0.0	0.11	0.11	0.11	0.60	0.60	0.60	0.21	0.21	0.21	0.07	0.07	0.07
2	32	5335	49990	0.0	0.0	0.0	0.08	0.08	0.08	3.06	3.06	3.06	0.26	0.26	0.26	0.01	0.01	0.01
2	32	5360	500 0	0.0	0.0	0.0	0.03	0.03	0.03	1.20	1.20	1.20	0.10	0.10	0.10	0.00	0.00	0.00
2	32	5335	50049	0.0	0.0	0.0	0.02	0.02	0.02	0.92	0.92	0.92	0.07	0.07	0.07	0.00	0.00	0.00
2	36	5265	50170	0.0	0.0	0.0	0.03	0.03	0.03	1.20	1.20	1.20	0.10	0.10	0.10	0.00	0.00	0.00
2	36	5267	50290	0.0	0.0	0.0	21.99	21.99	21.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2	37	5320	50220	0.8	0.8	0.8	9.29	9.29	9.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	37	5490	50255	0.0	0.0	0.0	0.03	0.03	0.03	1.16	1.16	1.16	0.09	0.09	0.09	0.00	0.00	0.00
2	38	5589	50270	0.0	0.0	0.0	0.04	0.04	0.04	1.56	1.56	1.56	0.13	0.13	0.13	0.00	0.00	0.00
2	38	5515	502 4	0.0	0.0	0.0	0.03	0.03	0.03	1.20	1.20	1.20	0.10	0.10	0.10	0.00	0.00	0.00
2	38	5514	50240	0.0	0.0	0.0	0.02	0.02	0.02	0.92	0.92	0.92	0.07	0.07	0.07	0.00	0.00	0.00
2	38	5525	50160	0.0	0.0	0.0	0.02	0.02	0.02	0.92	0.92	0.92	0.07	0.07	0.07	0.00	0.00	0.00
2	40	4840	50360	0.0	0.0	0.0	0.03	0.03	0.03	1.27	1.27	1.27	0.10	0.10	0.10	0.00	0.00	0.00
2	41	4970	50490	0.0	0.0	0.0	0.03	0.03	0.03	1.31	1.31	1.31	0.11	0.11	0.11	0.00	0.00	0.00
2	41	4925	50385	0.0	0.0	0.0	0.04	0.04	0.04	1.77	1.77	1.77	0.15	0.15	0.15	0.00	0.00	0.00
2	41	5050	50430	0.0	0.0	0.0	0.05	0.05	0.05	11.54	11.54	11.54	2.18	2.18	2.18	0.54	0.54	0.54
2	43	5283	50330	0.0	0.0	0.0	0.74	0.74	0.74	0.00	0.00	0.00	0.58	0.58	0.58	0.02	0.02	0.02
2	43	5257	50367	0.0	0.0	0.0	11.49	11.49	11.49	1.43	1.43	1.43	57.49	57.49	57.49	5.74	5.74	5.74
2	43	5267	50382	0.0	0.0	0.0	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	44	5345	50345	0.0	0.0	0.0	3.17	3.17	3.17	0.03	0.03	0.03	2.83	2.83	2.83	0.14	0.14	0.14
2	45	5490	50310	0.0	0.0	0.0	0.03	0.03	0.03	1.45	1.45	1.45	0.12	0.12	0.12	0.00	0.00	0.00
2	47	5188	50477	0.0	0.0	0.0	0.21	0.21	0.21	0.02	0.02	0.02	1.07	1.07	1.07	0.10	0.10	0.10
2	47	5174	50485	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	42.60	42.60	42.60	0.00	0.00	0.00
2	48	5236	50428	0.0	0.0	0.0	1.49	1.49	1.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	48	5234	50427	0.0	0.0	0.0	1.49	1.49	1.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	48	5230	50426	0.0	0.0	0.0	1.49	1.49	1.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	48	5236	50476	0.0	0.0	0.0	1.89	1.89	1.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	48	5220	50440	0.0	0.0	0.0	0.60	0.60	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	48	5200	50460	1.4	1.4	1.4	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	48	5230	50426	1.3	1.3	1.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	48	5253	50426	0.0	0.0	0.0	14.49	14.49	14.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	48	5226	50485	0.1	0.1	0.1	1.36	1.36	1.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	49	5322	50480	0.0	0.0	0.0	1.65	1.65	1.65	7.63	7.63	7.63	1.65	1.65	1.65	1.30	1.30	1.30
2	50	5464	50480	19.4	19.4	19.4	4.79	4.79	4.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	50	5489	50440	2.7	2.7	2.7	1.36	1.36	1.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	53	5210	50549	3.6	3.6	3.6	6.89	6.89	6.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	53	5235	50535	0.0	0.0	0.0	6.59	6.59	6.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	56	5899	506 1	0.0	0.0	0.0	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02
2	57	5[illegible]	[illegible]440	0.0	[illegible]	0.1	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02

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2	57	6030	50635	0.0	0.0	0.0	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02
2	57	6086	50693	0.0	0.0	0.0	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02
2	57	6150	50837	0.0	0.0	0.0	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02
2	58	5190	50760	5.4	5.4	5.4	0.13	0.13	0.13	0.02	0.02	0.02	0.77	0.77	0.77	0.07	0.07	0.07
2	58	5150	50780	0.1	0.1	0.1	3.82	3.82	3.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	58	5275	50615	0.0	0.0	0.0	0.99	0.99	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	58	5155	50785	0.0	0.0	0.0	0.90	0.90	0.90	0.00	0.00	0.00	0.45	0.45	0.45	0.00	0.00	0.00
2	59	5367	50675	0.0	0.0	0.0	0.03	0.03	0.03	1.29	1.29	1.29	0.11	0.11	0.11	0.00	0.00	0.00
2	60	5020	51075	7.9	7.9	7.9	6.99	6.99	6.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	60	5030	51080	9.9	9.9	9.9	13.59	13.59	13.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	60	5010	51085	5.5	5.5	5.5	10.79	10.79	10.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	60	5050	51050	0.0	0.0	0.0	0.56	0.56	0.56	20.79	20.79	20.79	1.75	1.75	1.75	0.10	0.10	0.10
2	60	5055	51070	0.0	0.0	0.0	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02
2	60	4775	50952	0.0	0.0	0.0	0.02	0.02	0.02	0.78	0.78	0.78	0.06	0.06	0.06	0.00	0.00	0.00
2	60	5060	51095	0.0	0.0	0.0	0.99	0.99	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	60	5040	51075	0.0	0.0	0.0	0.24	0.24	0.24	1.28	1.28	1.28	0.45	0.45	0.45	0.16	0.16	0.16
2	61	5150	50830	0.9	0.9	0.9	4.64	4.64	4.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	64	5150	51210	0.0	0.0	0.0	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02
2	64	4710	51180	0.0	0.0	0.0	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02
5	64	5080	51240	0.0	0.0	0.0	0.24	0.24	0.24	1.28	1.28	1.28	0.45	0.45	0.45	0.16	0.16	0.16
5	64	4990	511 0	0.0	0.0	0.0	0.21	0.21	0.21	1.16	1.16	1.16	0.41	0.41	0.41	0.15	0.15	0.15
2	68	5040	51490	0.0	0.0	0.0	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02
2	68	5035	51710	0.0	0.0	0.0	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02
2	68	4788	51570	0.0	0.0	0.0	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02
2	68	5045	51755	0.0	0.0	0.0	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	69	5395	51535	0.0	0.0	0.0	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02
2	70	5580	51565	0.0	0.0	0.0	0.14	0.14	0.14	5.19	5.19	5.19	0.44	0.44	0.44	0.02	0.02	0.02

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TABLE 31 SUMMARY OF AIR POLLUTANT EMISSIONS
TONS/[redacted] DAY

GRID	AREA	SOX			PART			CO			HC			NOX		
		S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
1	617.7	0.2	0.3	0.2	1.9	1.9	1.9	37.3	33.9	35.6	3.9	3.4	3.6	1.3	1.2	1.2
2	617.7	0.1	0.2	0.2	1.5	1.5	1.5	22.8	20.3	21.6	2.4	2.1	2.3	1.0	0.9	0.9
3	617.7	0.0	0.0	0.0	1.2	1.2	1.2	8.6	8.3	8.5	0.7	0.6	0.6	0.3	0.3	0.3
4	617.7	0.1	0.3	0.2	1.5	1.5	1.5	20.7	17.7	19.3	2.3	1.9	2.1	1.0	1.0	1.0
5	617.7	0.0	0.0	0.0	1.4	1.4	1.4	14.6	14.6	14.6	1.1	1.1	1.1	0.2	0.2	0.2
6	154.4	0.5	1.0	0.8	2.4	2.4	2.4	76.2	64.8	70.7	10.4	8.9	9.7	4.1	3.8	4.0
7	38.6	1.5	2.9	2.2	8.1	8.0	8.1	167.6	131.2	149.9	27.8	23.5	25.7	11.3	10.4	10.9
8	38.6	1.5	2.0	1.8	24.3	24.3	24.	64.2	53.3	58.9	7.6	6.3	7.0	2.9	2.6	2.7
9	38.6	0.1	0.2	0.2	0.3	0.3	0.3	9.5	7.1	8.4	1.5	1.2	1.3	0.8	0.8	0.8
10	38.6	0.1	0.2	0.2	0.3	0.3	0.3	9.5	7.1	8.4	1.5	1.2	1.3	0.8	0.8	0.8
11	154.4	0.3	0.4	0.3	3.7	3.7	3.7	29.4	26.9	28.2	6.2	5.9	6.1	2.6	2.5	2.5
12	154.4	0.0	0.1	0.1	1.3	1.3	1.3	11.2	10.2	10.7	1.1	0.9	1.0	0.6	0.5	0.6
13	617.7	0.0	0.0	0.0	1.2	1.2	1.2	8.7	8.4	8.5	0.7	0.7	0.7	0.4	0.4	0.4
14	617.7	0.0	0.0	0.0	1.3	1.3	1.3	11.8	11.5	11.7	0.9	0.9	0.9	0.3	0.3	0.3
15	617.7	0.1	0.2	0.2	2.7	2.7	2.7	41.2	39.5	40.4	4.3	4.0	4.2	0.8	0.8	0.8
16	617.7	1.4	3.3	2.4	41.2	41.1	41.1	241.2	207.4	224.8	46.5	42.0	44.3	12.2	11.4	11.9
17	617.7	0.3	0.5	0.4	7.3	7.2	7.3	81.6	74.5	78.2	10.2	9.2	9.7	3.2	3.0	3.1
18	617.7	0.1	0.2	0.1	6.8	6.8	6.8	70.8	68.8	69.8	7.2	7.0	7.1	1.6	1.5	1.5
19	617.7	0.1	0.1	0.1	2.1	2.0	2.1	21.2	19.4	20.3	2.7	2.4	2.6	0.8	0.7	0.7
20	154.4	0.3	0.4	0.3	5.4	5.4	5.4	61.3	52.9	57.2	8.6	7.5	8.1	2.5	2.2	2.4
21	154.4	0.1	0.3	0.2	0.4	0.3	0.3	13.2	9.8	11.6	1.9	1.4	1.7	0.9	0.8	0.9
22	154.4	0.1	0.2	0.2	2.0	2.0	2.0	28.2	22.2	25.3	5.1	4.4	4.8	1.7	1.4	1.6
23	38.6	2.3	2.4	2.4	0.8	0.8	0.8	10.1	7.5	8.8	1.4	1.1	1.3	0.7	0.6	0.7
24	38.6	0.1	0.2	0.2	0.7	0.7	0.7	10.1	7.5	8.8	1.4	1.1	1.3	0.7	0.6	0.7
25	38.6	1.2	2.7	2.0	3.0	3.0	3.0	132.6	98.5	116.1	18.5	14.1	16.4	8.7	7.6	8.2

TABLE 31 (Cont.)

26	38.6	0.1	0.3	0.2	0.3	0.3	0.3	18.0	13.3	15.7	2.3	1.7	2.0	1.0	0.9	1.0
27	617.7	0.4	0.8	0.6	5.1	5.1	5.1	83.0	72.3	77.8	12.6	11.2	11.9	3.7	3.4	3.6
28	617.7	0.1	0.3	0.2	3.3	3.3	3.3	38.5	34.0	36.2	4.7	4.1	4.4	1.6	1.5	1.6
29	617.7	0.2	0.4	0.3	1.7	1.7	1.7	39.8	34.5	37.2	5.2	4.6	4.9	1.6	1.5	1.5
30	617.7	2.8	3.5	3.2	7.8	7.8	7.9	74.1	57.2	65.9	10.2	8.0	9.1	4.6	4.1	4.4
31	154.4	0.3	0.7	0.5	0.9	0.9	0.9	37.9	28.5	33.4	5.6	4.4	5.0	2.7	2.4	2.5
32	154.4	0.3	0.5	0.4	1.8	1.8	1.8	45.1	36.5	41.0	6.0	4.9	5.5	2.7	2.6	2.7
33	154.4	0.1	0.1	0.1	0.2	0.2	0.2	9.5	7.2	8.4	1.4	1.1	1.3	0.7	0.6	0.7
34	154.4	0.0	0.1	0.0	0.8	0.8	0.8	8.4	7.5	7.9	0.8	0.7	0.7	0.4	0.4	0.4
35	154.4	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.1	1.3	0.2	0.2	0.2	0.1	0.1	0.1
36	154.4	0.4	0.9	0.7	23.4	23.4	23.4	53.8	41.0	47.6	8.0	6.4	7.3	3.7	3.4	3.6
37	154.4	1.2	1.5	1.3	11.3	11.3	11.3	52.6	41.2	47.1	7.4	5.9	6.7	3.6	3.3	3.5
38	154.4	0.2	0.4	0.3	1.3	1.3	1.3	38.2	30.5	34.5	5.4	4.4	4.9	2.3	2.2	2.3
39	617.7	0.1	0.2	0.2	1.6	1.6	1.6	19.5	16.7	18.1	2.3	1.9	2.1	1.1	1.0	1.1
40	617.7	0.1	0.2	0.2	0.8	0.8	0.8	16.0	13.1	14.5	2.1	1.8	2.0	0.9	0.8	0.8
41	154.4	0.5	1.1	0.8	1.9	1.9	1.9	77.9	62.7	70.5	12.1	10.2	11.2	4.7	4.3	4.5
42	38.6	1.2	2.7	2.0	2.7	2.8	2.8	97.7	74.2	86.4	15.0	12.0	13.6	6.5	6.2	6.4
43	38.6	5.3	13.0	9.3	15.8	16.8	16.3	82.7	63.7	73.5	71.0	68.8	69.9	13.3	16.2	14.9
44	38.6	3.5	9.5	6.7	5.4	6.2	5.9	65.2	49.9	57.8	12.9	11.1	12.1	5.7	4.0	4.9
45	38.6	0.7	1.7	1.2	0.9	1.0	0.9	28.1	21.7	25.0	4.2	3.4	3.8	2.2	2.4	2.3
46	154.4	0.2	0.4	0.3	0.3	0.4	0.4	10.7	8.1	9.4	1.7	1.4	1.5	0.9	0.9	0.9
47	38.6	0.9	1.8	1.3	7.2	8.1	7.1	105.8	77.8	92.3	58.0	54.4	56.2	6.4	5.2	5.8
48	38.6	9.8	18.7	14.5	27.6	29.7	28.2	105.7	76.7	89.1	16.3	13.1	14.6	9.4	12.6	11.1
49	38.6	2.3	6.2	4.4	3.2	3.7	3.4	46.1	37.1	41.8	7.8	6.8	7.3	4.9	6.4	5.7
50	38.6	23.0	23.8	23.4	7.4	7.5	7.4	29.4	22.6	26.1	4.9	4.0	4.4	2.9	4.1	3.0
51	154.4	0.4	0.7	0.5	0.4	0.5	0.4	11.7	8.8	10.3	1.7	1.4	1.6	1.1	1.1	1.1
52	38.6	0.6	0.7	0.7	1.1	1.0	1.0	97.7	71.5	85.0	12.9	9.5	11.3	5.9	4.6	5.3
53	38.6	6.4	7.1	6.8	10.7	11.6	10.7	175.0	129.3	153.1	24.0	18.3	21.2	12.1	11.5	11.3
54	38.6	0.6	1.0	0.8	1.2	1.2	1.2	31.0	23.8	27.5	5.2	4.1	4.6	2.9	3.0	3.0

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TABLE 31 (Cont.)

55	38.6	0.1	0.2	0.1	0.2	0.2	0.2	4.6	3.5	4.1	0.8	0.7	0.7	0.5	0.5	0.5
56	617.7	0.2	0.3	0.2	0.4	0.4	0.4	13.1	11.2	12.2	1.7	1.4	1.6	0.7	0.7	0.7
57	617.7	0.1	0.1	0.1	0.6	0.6	0.6	22.7	22.2	22.5	2.0	2.0	2.0	0.2	0.2	0.2
58	154.4	7.2	8.1	7.7	7.3	7.3	7.3	39.2	29.8	34.6	7.4	6.2	6.8	4.2	4.4	4.3
59	154.4	0.2	0.4	0.4	0.6	0.6	0.6	14.3	11.2	12.8	2.2	1.8	2.0	1.3	1.3	1.3
60	617.7	24.3	24.8	24.6	33.8	33.9	33.9	43.3	39.6	41.5	5.0	4.5	4.7	2.0	2.2	2.1
61	154.4	1.3	1.6	1.5	4.9	4.9	4.9	13.5	10.0	11.8	1.9	1.5	1.7	1.0	1.0	1.0
62	154.4	0.2	0.4	0.3	0.2	0.2	0.2	11.0	8.1	9.6	1.6	1.2	1.4	0.8	0.7	0.8
63	617.7	0.0	0.1	0.1	0.0	0.0	0.0	2.1	1.6	1.8	0.3	0.2	0.3	0.1	0.1	0.1
64	617.7	1.5	2.9	2.3	1.9	1.9	1.9	78.2	68.3	78.6	12.4	9.8	11.2	5.4	4.9	5.2
65	617.7	0.1	0.2	0.2	0.1	0.1	0.1	5.5	4.0	4.8	0.8	0.6	0.7	0.4	0.3	0.3
66	617.7	0.1	0.3	0.2	0.1	0.1	0.1	7.4	5.5	6.5	1.1	0.8	0.9	0.5	0.4	0.5
67	617.7	0.0	0.1	0.1	0.0	0.0	0.0	1.9	1.4	1.7	0.3	0.2	0.3	0.1	0.1	0.1
68	617.7	1.0	1.9	1.5	1.8	1.8	1.8	60.4	48.0	54.8	7.7	6.2	7.0	3.2	2.8	3.0
69	617.7	0.4	0.8	0.6	0.5	0.5	0.5	24.3	19.3	21.9	3.2	2.5	2.9	1.3	1.2	1.3
70	617.7	0.2	0.3	0.3	0.3	0.3	0.3	12.8	10.8	11.8	1.5	1.3	1.4	0.5	0.5	0.5
71	617.7	0.1	0.2	0.2	0.1	0.1	0.1	5.1	3.8	4.5	0.7	0.6	0.6	0.4	0.3	0.3

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EMISSION DENSITIES

In order to provide a visual representation of the emissions of pollutants by grid, emission density maps have been provided. Figures 6 through 10 show variation in emission densities for the respective grids throughout the Study Area. As expected the emissions generally follow the pattern and degree of urbanization. Emission densities are higher in grids with high populations and correspondingly high vehicular and industrial activity.

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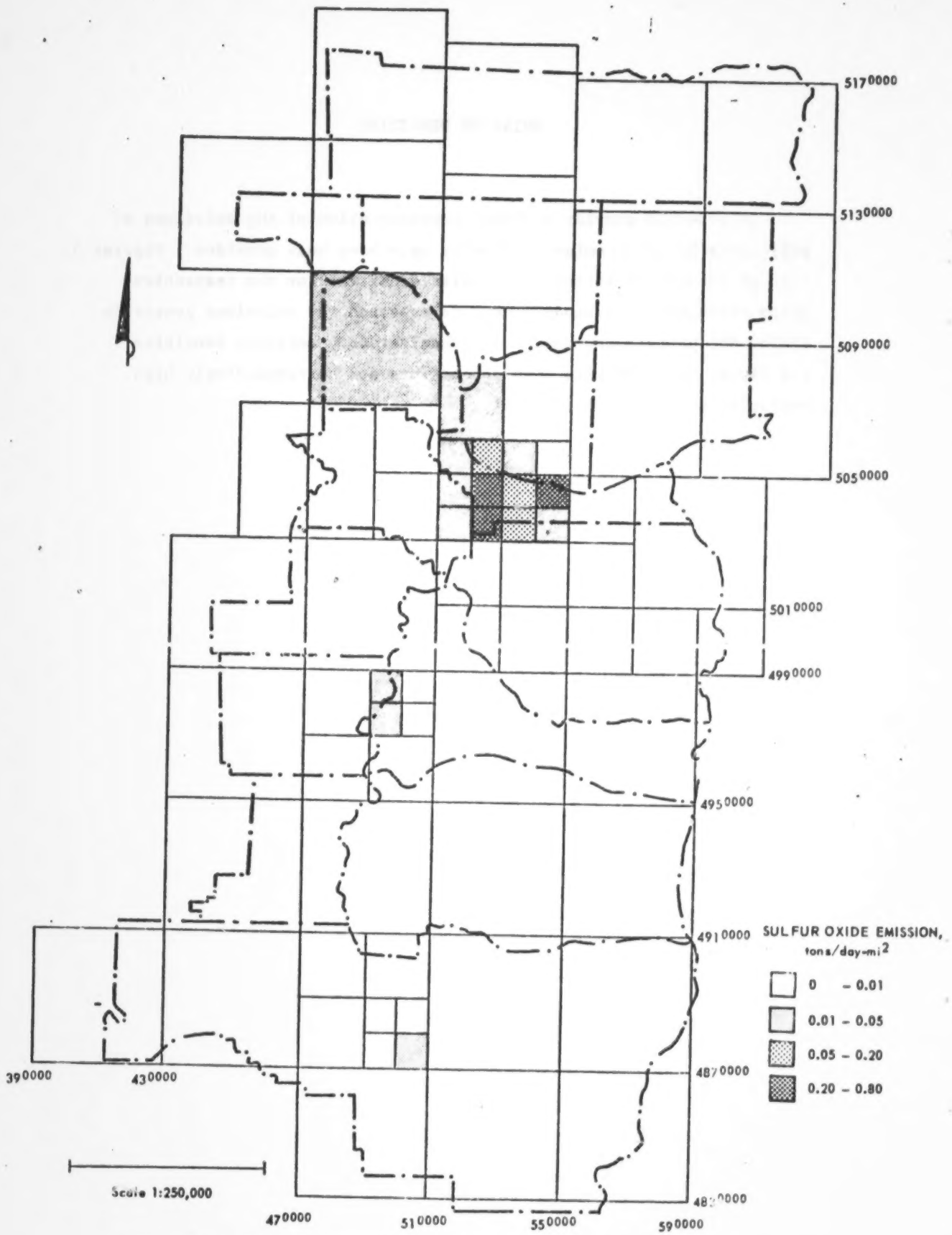

Figure 6. Sulfur oxide emission density for Willamette Valley study area, 1968.

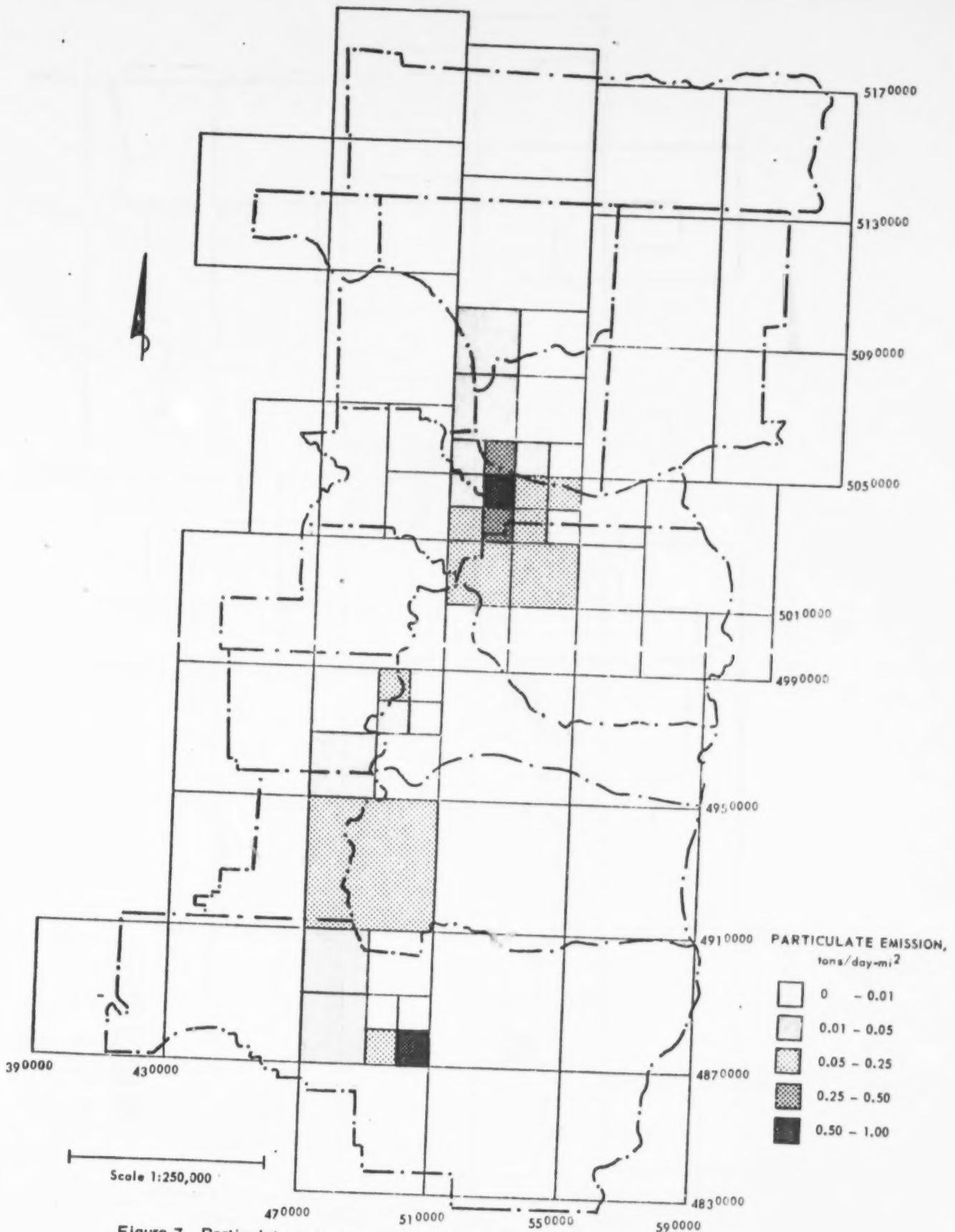

Figure 7. Particulate emission density for Willamette Valley study area, 1968.

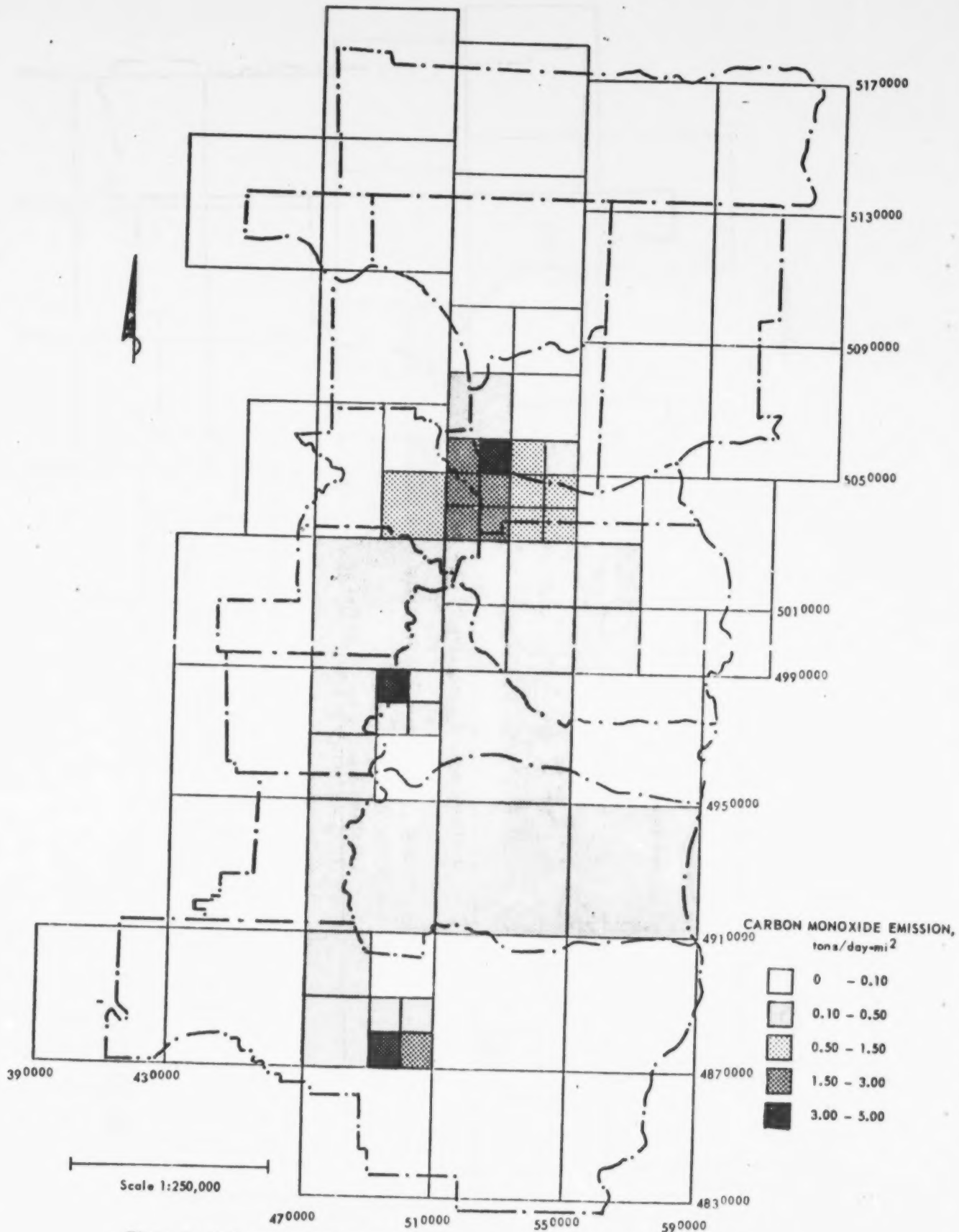

Figure 8. Carbon monoxide emission density for Willamette Valley study area, 1968.

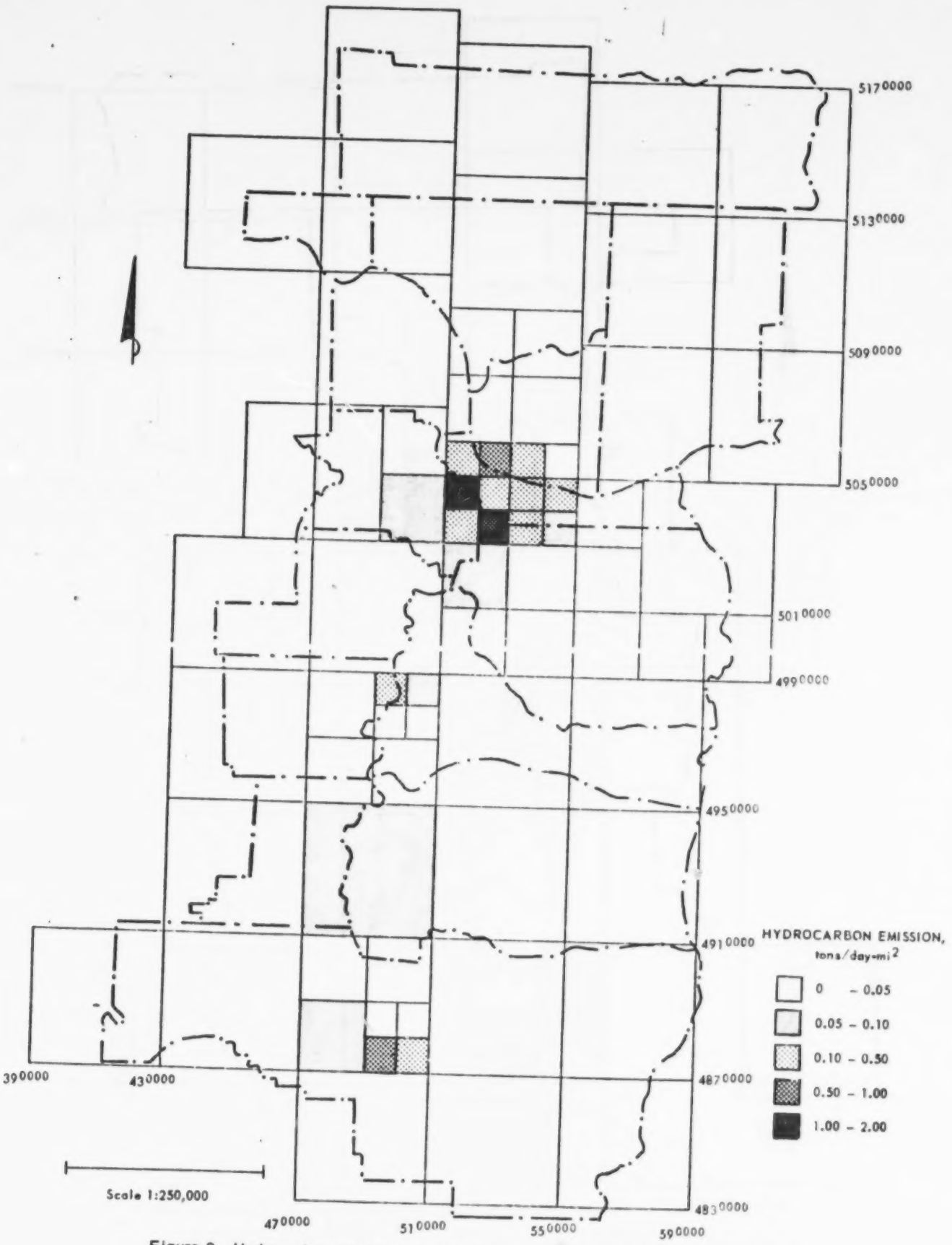

Figure 9. Hydrocarbon emission density for Willamette Valley study area, 1968.

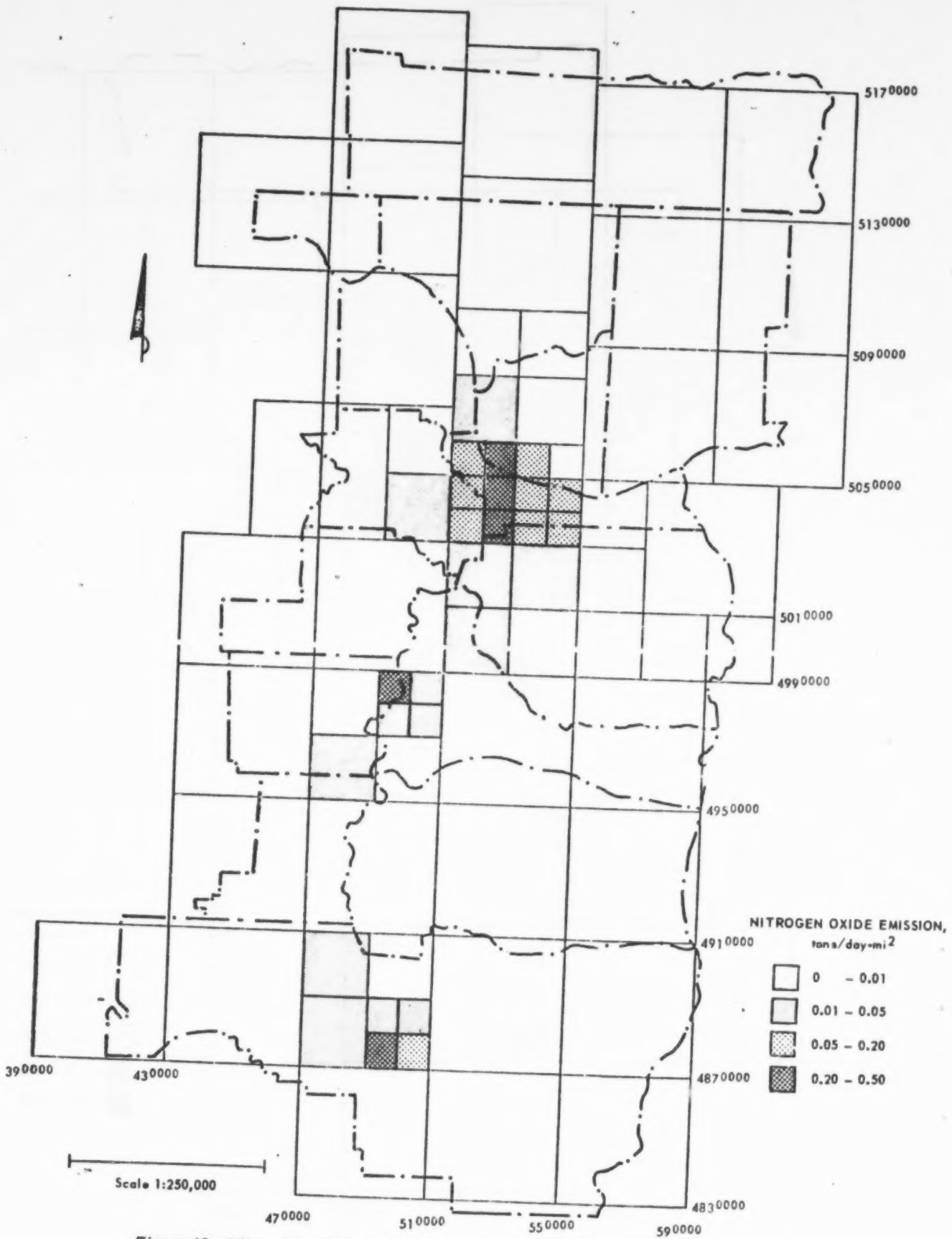

Figure 10. Nitrogen oxide emission density for Willamette Valley study area, 1968.

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8. Data from Oregon State Sanitary Authority, Air Quality Control Section.

APPENDIX

METHOD FOR CALCULATING SUMMER, WINTER AND ANNUAL AVERAGE EMISSIONS FOR FUEL CONSUMPTION IN STATIONARY SOURCES

YEARLY AVERAGE (A)

$$A = \frac{\text{Fuel Consumed} \times \text{Emission Factor (E. F.)}}{\text{Days of Operation}}$$

e.g. A plant consumed 100,000 tons of coal in 1967 while operating 365 days. The total degree days for the area was 4,800 and 2,800 for the three winter months. The plant was estimated to use 15 percent of the fuel for space heating and 85 percent for process heating. From this information, the annual average emission for carbon monoxide would be the following:

$$A = \frac{100{,}000 \text{ Tons/year} \times 3 \text{ lbs. CO/Ton coal}}{365 \text{ Days/year} \times 2{,}000 \text{ lb./Ton}}$$

$$A = 0.41 \text{ Ton/Day}$$

WINTER AVERAGE (W)

$$W = \frac{\text{Fuel Consumed} \times \text{E.F.}}{\text{Days of Winter Operation}} \times \frac{\text{Winter Degree Days}}{\text{Total Degree Days}} \times \text{\% Fuel Used for space heating}$$

$$+ \frac{\text{Fuel Consumed} \times \text{E.F.}}{365} \times \text{\% Fuel used for process heating}$$

$$W = \left[\frac{100{,}000 \times 2{,}800}{90 \times 4{,}800} \times 0.15 + \frac{100{,}000}{365} \times 0.85\right] \frac{3}{2{,}000}$$

$$W = 0.49 \text{ Ton/Day}$$

SUMMER AVERAGE (S)

$$S = \frac{\text{Fuel Consumed} \times \text{E.F.}}{\text{Days of Summer Operation}} \times \frac{\text{Summer Degree Days}}{\text{Total Degree Days}} \times \text{\% Fuel Used for space heating}$$

$$+ \frac{\text{Fuel Consumed} \times \text{E.F.}}{365} \times \text{\% Fuel used for process heating}$$

$$S = \left[\frac{100{,}000}{90} \times \frac{0}{4{,}800} \times 0.15 + \frac{100{,}000}{365} \times 0.85\right] \frac{3}{2{,}000}$$

$$S = 0.35 \text{ Ton/Day}$$

APPENDIX B
METRIC CONVERSION FACTORS

Multiply	By	To Obtain
Feet	0.3048	Meters
Miles	1609	Meters
Square Feet	0.0929	Square meters
Square Miles	2.59	Square kilometers
Pounds	453.6	Grams
Pounds	$453.6/10^4$	Tons (metric)
Tons (metric)	1.103	Tons (short)
Tons (short)	907.2	Kilograms
Tons (short)	.9072	Tons (metric)

To Obtain	By	Divide

APPENDIX C

EMISSION FACTORS

	Wigman lb/unit (dry)	Wood Boiler lb/unit (dry)	Slash Burning lb/ton	Field Burning lb/ton
Sulfur Oxides	0.2	N	N	N
Particulate	7	4	10	16
Carbon Monoxide	260	0.5	64	101
Hydrocarbons	22	20	3.2	12.3
Nitrogen Oxides	1.3	2	2	2

One unit (dry) is approximately one ton.